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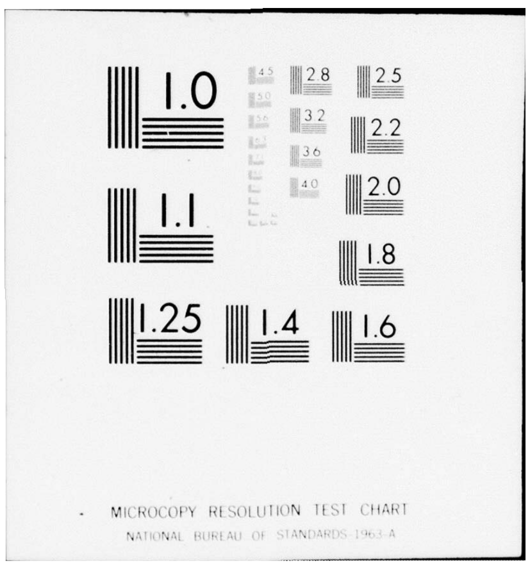
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UNITED STATES AIR FORCE

AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

A REQUIREMENTS STUDY FOR AN AUTOMATED
MAINTENANCE DATA COLLECTION SYSTEM
FOR THE ROKAF F-4 WEAPONS SYSTEM

William J. Callahan, Captain, USAF
D. C. Payne, Squadron Leader, RAAF

LSSR 24-77A

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The Republic of Korea Air Force obtains follow-on support for their F-4 fleet from a Special Support Arrangement obtained through the United States Air Force Technical Coordination Group. This SSA is renegotiated each year and the ROKAF requires figures on equipment failures in order to be able to stipulate which items require inclusion in the SSA. This thesis shows the development of a management information system in a computer model to output a number of reports which the TCG believes will be appropriate for use by the ROKAF to enable managerial control of failures. The reports produced are analyzed and shown in detail, together with a discussion of the data requirements and listings of report examples.

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A REQUIREMENTS STUDY FOR AN AUTOMATED MAINTENANCE DATA COLLECTION SYSTEM FOR THE ROKAF F-4 WEAPONS SYSTEM

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Logistics Management

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This thesis, written by

Captain William J. Callahan

and

Squadron Leader D. C. Payne

has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements for the degree of

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Daniel Edward Reynolds

COMMITTEE CHAIRMAN

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CHAPTER I

INTRODUCTION

> Since World War II, the United States has been assisting friendly foreign countries in establishing and maintaining adequate defensive postures, consistent with their economic stability and growth, to maintain internal security and resist external aggression [8:A-1].

In light of this intention, the United States government has developed a program of both military and economic assistance to certain selected foreign countries, known as Security Assistance countries (SA).

> As a program, Security Assistance comprises the sale of defense articles and services, the grant of such articles and services without reimbursement in appropriate cases, economic supporting assistance in exceptional cases to offset costs of maintaining armed forces, and grant assistance to public safety forces such as police [8:A-1].

The Department of Defense (DOD) is responsible for the administration of the Foreign Military Sales (FMS) program as part of U.S. Security Assistance. Included as part of the FMS program are the actual sale of defense articles and services, and the extension of guaranteed credit when appropriate (8:A-1). However, the overriding constraint of aid to SA countries is that ". . . it shall support and be in consonance with United States military strategic plans and objectives. . . [8:C-1]."

United States and Korea

The United States military assistance to Korea was originally implemented by the Mutual Assistance Act of October 1949. This Act included the provision that the United States would provide expert advice and technical help in the production of military equipment and in the training of personnel (17:6). In fact, the whole of the Republic of Korea (ROK) foreign policy

> . . . is characterized by close ties with the United States and by strong motivation to establish the nation as a recognized power within the community of nations of the free world. The primary objective is the reunification of North and South Korea [17:18].

It was through United States participation in the Korean War (under the aegis of the United National Emergency Force) that military ties between the two countries were cemented; this mutual assistance has been further solidified by the Korea-United States Bilateral Treaty of 1954 and the participation of Republic of Korea troops in the Vietnam conflict. The ROK is presently actively participating in the FMS program as a member SA country.

F-4 Weapons System

Through the SA program the United States Air Force (USAF) has agreed to provide technical support for the integration of the F-4 weapon system throughout the SA countries' armed forces (12:1):

> In accordance with Air Staff direction at the 13-14 July 1972 meeting, a plan has been developed to furnish engineering/technical support to foreign users of the F-4 aircraft . . . all countries possessing F-4 aircraft supported by the Air Force . . . will participate fully in sharing the benefits and costs [12:1].

Maintenance Data

As part of the assistance granted to Korea, DOD accepts the responsibility under the FMS agreement to provide the capability to maintain the operational readiness of Republic of Korea Air Force (ROKAF) weapon systems (8:C-3). Therefore, with reference to this readiness it is worth noting that:

> One of the first essentials in dealing with the matter of equipment readiness in the Department of Defense is the existence of an effective information system capable of providing accurate data on the condition and degree of readiness of all equipment currently in inventory [6:8].

Not only has the DOD accepted responsibility for the sale of military weapons systems to the Republic of Korea, but also the task of providing programs to insure the maintainability and operational readiness of these weapon systems (8:C-3).

The need for an effective maintenance information system has become critical to the ROKAF because of the method by which the country justifies receipt of necessary military supplies; one year before a requirement for spares exists the ROKAF must provide the DOD with information as to anticipated usage of particular weapon system components.

This enables the DOD to budget for the purchase of these necessary weapon system components. Thus, if the ROKAF cannot provide accurate information as to anticipated usage of particular components, they are not necessarily assured of required support (20).

The collection of maintenance data is important in isolating weapon system components which demonstrate trends of high failure rates; this information is required to justify and develop usage rates for future consumption. "An effective logistic support system cannot function without having accurate data on consumption and usage [2:4]."

The USAF currently stores its maintenance data on computer tapes via a sophisticated computer program. Much of the information provided by this program in the form of output reports is not suitable to the needs of the ROKAF because of a difference in utilization of this data (based on the size differential between USAF and ROKAF). In addition, the USAF will not enter technical data peculiar to a foreign country into the USAF technical data system. Unfortunately this has caused some conflict because:

> In accordance with current policies, Air Force Systems Command is totally responsible for a Foreign Military Sales Program until delivery of the last contract article under the case has been accomplished . . . [and] AFSC could be left "holding the ball" for non-standard items/technical data indefinitely, or, at least until the foreign country decides to generate a support case through Air Force Logistics Command or contracts directly with the end item contractor [11:2].

Hence the need for the development of a country-peculiar maintenance data collection system.

Maintainability of F-4 Aircraft

The USAF has developed computer programs to assist in the maintenance of aircraft through the storage, manipulation, and output of F-4 weapon system performance data for utilization in analysis of future spares requirements. This information is extensive: "The USAF currently obtains millions of elements of technical information concerning the operations and maintenance of F-4 aircraft each month [24:1]." Therefore the USAF is able to extract a multitude of information for its own purposes; unfortunately most has little applicability to a SA country with a smaller Air Force operating under a completely different mission environment. Strictly applying these computer programs directly to the ROKAF might result in an information overload, combined with inappropriate reports and failure to output needed reports. However, the system used by USAF has been found appropriate for USAF needs.

> Because of the availability of this [maintenance] information, we [the USAF] have been able to correct deficiencies before they occur. We have, therefore, been able to prevent aircraft damage or possible loss and to save a great deal of money and lives of crew members [24:1].

Problem Statement

The ROKAF does not have its own automated Maintenance Data Collection System (MDCS) to furnish accurate and

timely maintenance data. Under present circumstances the ROKAF relies on USAF data manipulation programs to provide required information on high failure rates of F-4 weapon system components, but this system has not proven viable: unfortunately the USAF data system also provides much information that lacks applicability to the ROKAF; in addition, for security reasons, the complete information on all USAF F-4 weapon systems are not made available to the ROKAF (20). This is not to say that, in a general sense, the existing exchange of information is not of use to both parties. Mutual benefits have been realized:

> Because of the differences between USAF and United States Security Assistance (SA) countries F-4 operations and environment, there may be some kinds of technical deficiencies which occur in the SA country fleets before they are known to the USAF. At the same time, the countries may be having serious difficulties because of deficiencies already recognized and corrected in the USAF F-4 fleet [24:1].

The problem of nonapplicability or inadequacy of some data could be resolved through the development of a ROKAF-peculiar computer based MDCS which, in combination with a Maintenance Data Retrieval System (MDRS), would be the basis for providing required maintenance data. If such a maintenance data system can be tailored to the ROKAF's needs and resources, providing only pertinent maintenance information, an improvement in the overall performance of the ROKAF F-4 weapon systems performance can be expected (20). In addition, the development of the

MDCS would enable the ROKAF to estimate future maintenance demands and thereby ensure supply of F-4 weapon system components under the provisions of the FMS agreement: "One year in advance each country must know what they will require (based on past consumption) highlighting high failure items [20]."

Background to Problem Statement

Contrary to the belief that Asian countries have a surfeit of labor, this is not the case in the ROKAF. "There is a current shortage of manpower authorizations and the promise of further cutbacks due to budgetary constraints may be necessary [20]." However, to negate the effects of limited manpower authorizations, the ROKAF has purchased modern computer hardware; unfortunately they now lack the necessary software packages to implement computerization of their maintenance data collection efforts. ROKAF currently compiles its reports manually utilizing fifty man months in preparing the following years' budgeted demands; ROKAF management consider a preparation time of fifty man months to be excessive and believe that a mechanical system would prove to be more efficient (20).

> The system the ROKAF is presently using is both time consuming and inefficient. Almost 50 man months are invested to produce each [budget] report. Additionally the present system does not have a provision for identifying items which should be candidates for Special Support Agreements [19:3].

Through the use of a unique computer MDCS, information relating to failure items would be quickly compiled into a report designed to assist in the preparation of the following years' budget demands for spare parts. Hence, as the ROKAF have the necessary computer equipment, the main task is to provide maintenance data collection programs that will enable the ROKAF personnel to input data and receive an output that is suitable to their requirements.

Technical Coordination Group (TCG)

The information obtained from USAF maintenance computer programs has been most useful to the USAF and an attempt is being made to permit availability of applicable information to other SA countries operating the F-4 weapon system (24:2); this information coordination effort will be handled by the establishment of a Technical Coordination Group (TCG) which would

> . . . provide a single contact point for the collection and analysis of both USAF and SA country technical engineering data and to communicate directly with both USAF agencies and participating SA countries to assist in solving mutual, as well as participating countries' peculiar problems [24:2].

Refer to Figure 1 for a diagramatic representation of this interface.

The SA countries were contacted and advised of the proposed formation of the TCG and its functions (15); all

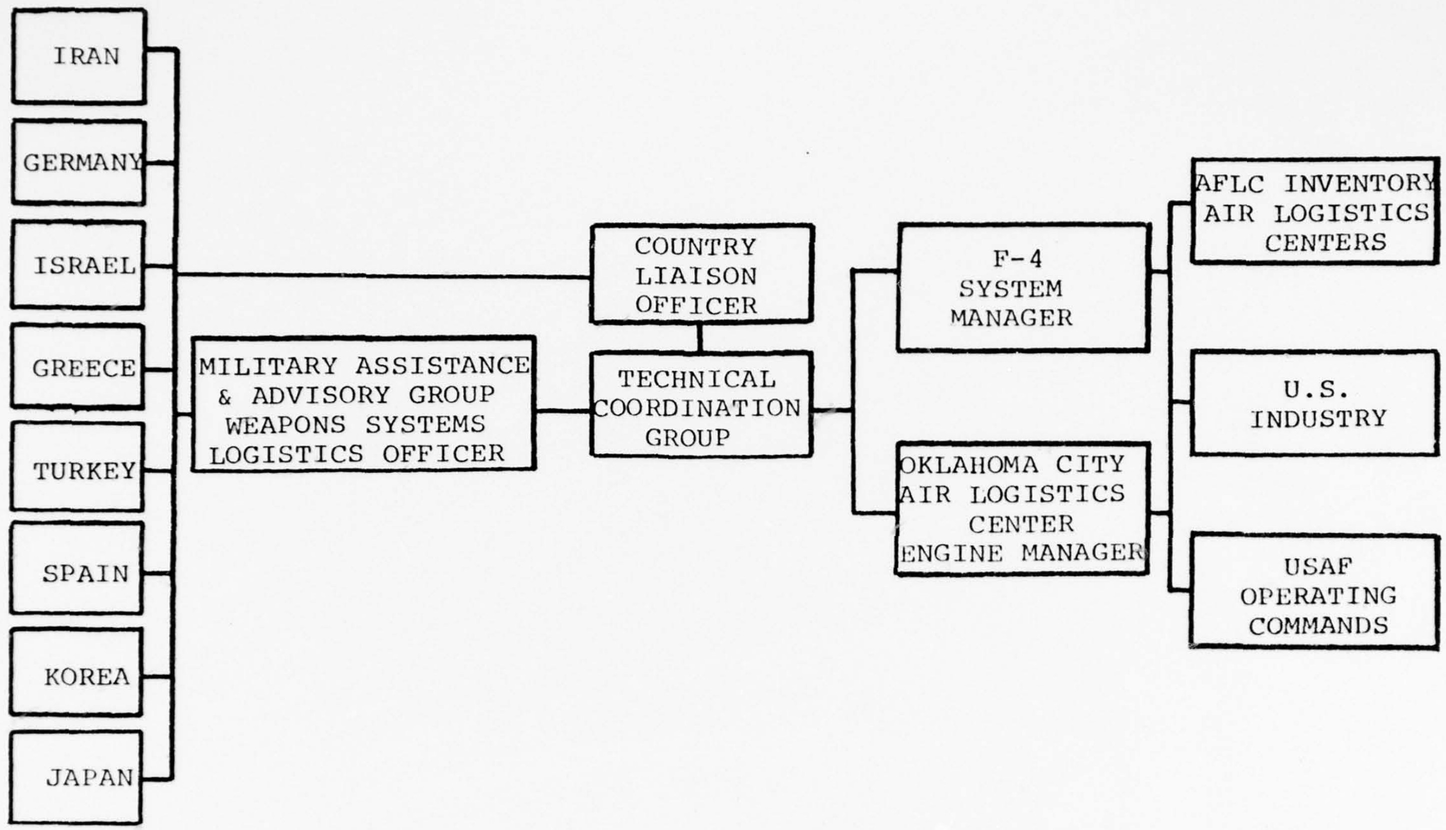

Figure 1. F-4 Technical Coordination Group Lines of Communication

but one country[1] were enthusiastic about the possibilities offered by the TCG (9). However, as previously stated, the foreign maintenance information available could not be entered into the USAF computerized system without causing disruption to USAF data (31). When the TCG representatives made their first implementation visit to the Republic of Korea, they stressed the importance of the development of a country-peculiar MDCS (23:1). As a result of the interest expressed by ROKAF officials, the TCG was assigned the responsibility for adapting the existing USAF MDCS programs for SA countries' use (10). Officials of the TCG conducted a review of existing programs and

> . . . decided that a modification of the existing USAF data products would require more effort than developing an entirely new program because of the lack of documentation [18:1].

As a result of these initial conferences and deliberations, the responsibilities of the TCG were to include (1:5):

a. interfacing USAF and SA country data systems;

b. entering data into the USAF maintenance computer system or <u>a separate reporting system would be developed tailored to peculiar SA country needs</u> (authors' emphasis); and

---

[1]This one country was unable to budget the money necessary for TCG participation until 1977.

c. reviewing USAF maintenance data records for trends in product performance which may have applicability for SA countries (16:4).

Justification

From the outline above it becomes evident that the TCG will be responsible for the development and implementation of the maintenance data collection system for the ROKAF. Thus the TCG is required to develop a MDCS that is not only suited to the ROKAF needs but that can be later applied to the needs of other SA countries.

The information obtained from the MDCS must assist in the isolation of trouble spots for the future:

> In today's environment, a high degree of materiel readiness is of paramount importance in defense planning. Maintenance is a major contributor to this readiness. It is the job of maintenance to sustain equipment in a state of operational readiness consistent with the demands of the operating forces [6:iii].

This becomes of paramount importance for the ROKAF; if they do not forecast future demands in sufficient time for inclusion in the next year's SSA they are not assured of receiving critical supplies.

But why the need for such a reliance on computer systems? The major characteristic that delineates the computer from other managerial aids is the immediate response capability (26). This rapidity of information has

become of paramount importance with the development of military fast strike capabilities:

> . . . mobilization time has been reduced from months to days and hours--perhaps in extreme cases to only minutes. Since it would be disastrous to delay mobilization until hostilities begin, it is necessary to be in a continued state of emergency readiness and to be capable to respond rapidly in order to maximize our military advantage [6:2].

The problem of equipment readiness has been further delineated as:

> One of the first essentials in dealing with the matter of equipment readiness in the DOD is the existence of an effective information system capable of providing accurate data on the condition and degree of readiness of all equipment currently in the inventory [6:8].

Research Objectives

The objectives of this thesis were to fulfill the following requirements:

1. delineate the maintenance data requirements of the ROKAF F-4 weapon system as they relate to manhours accounting and component identification for inclusion in the special support agreement (SSA);

2. provide maintenance data that will enable ROKAF management to specifically identify these system requirements, based upon information on the following factors:

    a. failure rates,

    b. mission aborts, and

    c. usage of manhours in the maintenance function;

3. provide a MDCS suitable to ROKAF management which would enable production of maintenance data in an informative and meaningful format (i.e., numeric and graphic presentations of components deficiencies with respect to Quality Control inspections); and

4. facilitate manhour accounting and provide data to support redistribution of manpower (19:3).

The above research objectives served as guides in the development of a MDCS aimed at achieving more effective control of the ROKAF maintenance function. In this context, the introduction of a computer-based system into the maintenance management of the F-4 weapon system within the ROKAF would exhibit the following characteristics that delineate it from the manual system:

1. the MDCS is faster than the manual system,

2. it is more accurate, and

3. there is a decreased requirement for labor in preparation of control and maintenance reports.

Preview of Remaining Chapters

The objective of this chapter has been to give some description of the scope of the problem through specification of the background to the situation and some discussion of the perspectives involved. In addition, the research objectives were stated to show the direction of this thesis.

The next chapter will describe the research methodology to be utilized to provide some insight into the four research questions posed, as well as describing the output format. Chapter III will describe the MDCS developed, going into greater detail on each of the elements and subroutines of the model developed, together with some discussion of the data manipulation.

Chapter IV will describe the results obtained from testing the developed MDCS with simulated data; the final chapter will discuss conclusions about the model usage, outlining the limitations thereto; finally, recommendations will be made with respect to directions for future development of the MDCS.

CHAPTER II

METHODOLOGY

Overview

The purpose of this chapter is to describe the overall system that was developed to enable the construction of an integrated computer-based Maintenance Data Collection System (MDCS). The first section of the chapter will discuss the basic system developed, followed by a discussion of data collection and utilization; the final section will give a clearer definition of each of the outputs--the individual subsystems will be examined and their procedures described in order to specify explicitly the responsibilities of each (3:63-65).

System Manipulation

The purpose of the MDCS is to collate data obtained from all maintenance work centers within the ROKAF that are responsible for support of the F-4 fleet; the data so obtained will be manipulated in order to obtain definitive data on the reliability of each component of the weapons system, isolation of systems requiring inordinate maintenance time, together with manhour accounting functions. The system flowchart shown as Figure 2 is illustrative of

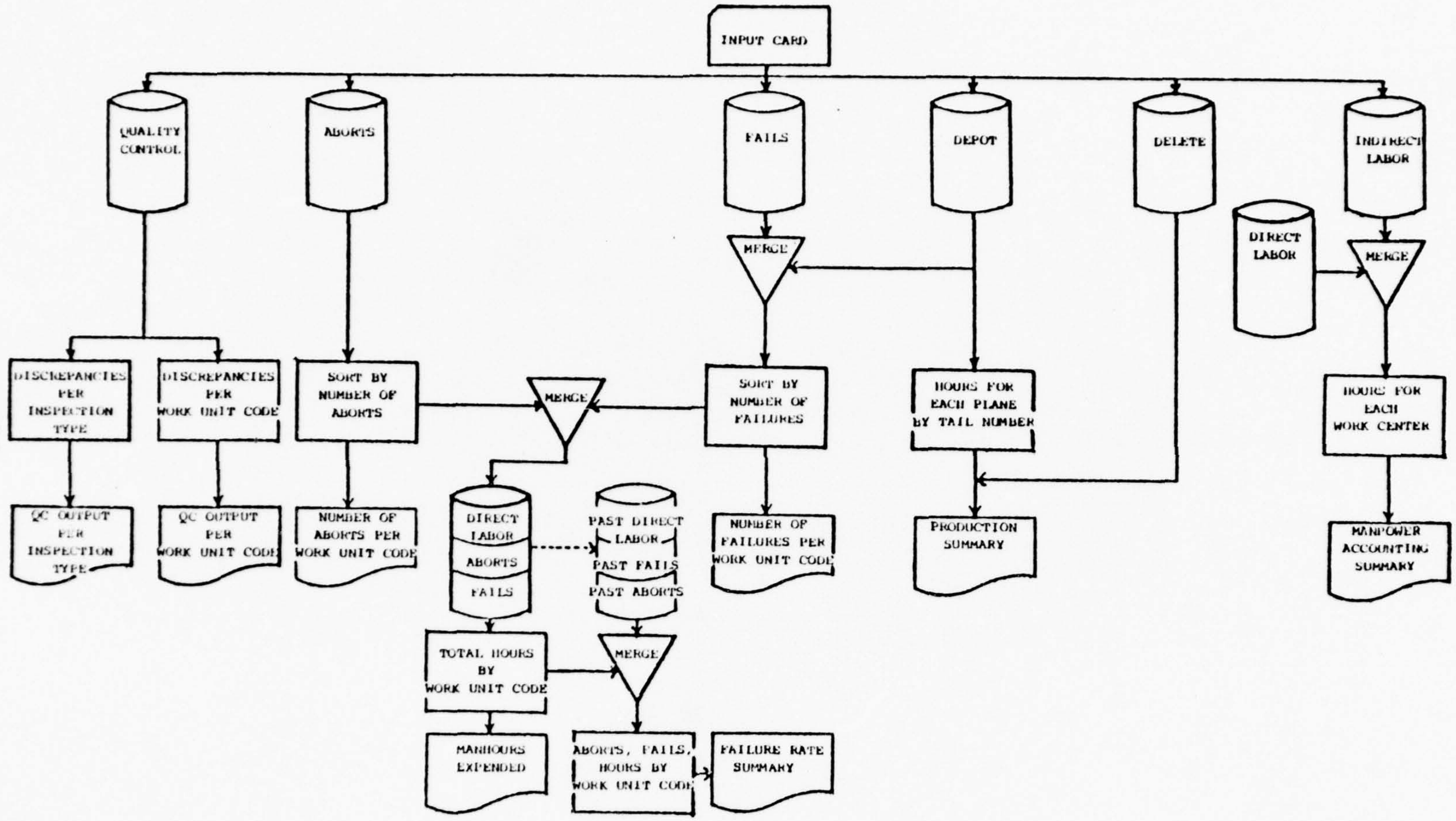

Figure 2. Data System Manipulation Flowchart

the whole process utilized to obtain the requisite output, each of the outputs being labeled as shown; the eight types of reports output have been named and the same terminology will be used with respect to these reports throughout this chapter.

Data Input

The data used in this system will be the subject of further discussion at a later section of this chapter; suffice it to state at this stage that the input data comes from three basic sources:

a. Air Force forms 349,

b. quality control cards, and

c. production summary delete cards.

As can be seen from Figure 2, these basic inputs are utilized to create six data files:

a. quality control data,

b. data on mission aborts,

c. data on equipment failures,

d. depot maintenance data,

e. delete data for file maintenance purposes, and

f. manpower accounting data (indirect labor).

Quality Control Data

The quality control data is generated from quality control inspections performed on aircraft at various times in the maintenance function (e.g., preflight inspections,

post-maintenance inspections, etc.). The data so generated is used to obtain two outputs:

a. graphical presentations of rates of discrepancies per inspection type, referred to as "QC Output per Inspection Type;" and

b. listings (in tabular form) of discrepancies discovered per work unit code (WUC) referred to as "QC Output per WUC."

These reports enable ROKAF management to observe trends in equipment malfunctions in order to obtain replacement spares prior to the arisal of "not operationally ready supply" (NORS) situations; the second part of the report will also be used to define work unit codes that have caused the greatest number of inspection discrepancies, and hence requiring greater attention during maintenance in order to decrease the number of errors.

Mission Abort Data/Failure Data

The information generated from the mission abort data file is used to compile a monthly listing of those work unit codes which have resulted in the incidence of aborts; these instances are listed in descending order of importance in terms of number of instances; this is the "number of Aborts per WUC" report. Likewise, the information obtained from the failure and depot maintenance data files is used to produce an output by work unit code of those

items which have resulted in equipment failures over the month of the report; this is the "Number of Failures per WUC" report. This data on aborts and failures is further analyzed to produce a report output by WUC accounting for total manhours expended on maintenance. The report shows total hours expended per WUC on maintenance; this is the "Manhours Expended" report--it deals solely with direct labor.

Abort/Failure Manhour Summary Data

The data files for aborts, failures, and depot maintenance are merged to represent a data file for all elements of aborts, failures, and manhours expended on the F-4. This data is used to provide a report for each work unit code, comparing the previous and current months data on mission aborts, equipment failures, and resultant manhour utilization. This report has three elements of information:

a. data on occurrences and ranking of failures for this and the previous month;

b. data on occurrences and ranking of aborts for this and the previous month; and

c. data and ranking of hours expended on failures and aborts for this and the last month.

This report is used to isolate those work unit codes which are causing the greatest burden to the maintenance function

because of mission aborts and equipment failures, which both result in manpower utilization.

Depot Maintenance Data

The primary function of the depot maintenance data is to produce a report which shows the usage of manhours in the maintenance function for each aircraft that is in the depot and which has undergone maintenance in the past three months. The actual manhour usage is compared to that authorized, and a comparison is made of the two figures, differences being highlighted as being under- or over-usage. This is the "Production Summary" report. The delete data file is used for the purpose of file maintenance on the production summary data.

Manhour Utilization

The final subsection of the system is concerned with manpower utilization. The report compares the number of men assigned against the number authorized for each work center and/or depot and then lists all labor under the categories of "direct" labor, "indirect" labor, and "other," a category containing manhours not reported via AF form 349 (e.g., periods of no activity within the work center). Each of these categories is costed out and a percentage of authorized and assigned manpower is tabulated. This is the "Manpower Accounting Summary" report.

Data Collection/Manufacture

Data for utilization in the system was available through two sources: (a) Korean data forwarded through Odgen Air Logistics Center at Hill Air Force Base, and (b) through artificial generation via a data program utilizing the random number facility of the CREATE computer at AFIT SLG.

The establishment of a data base was necessary to permit initial tests of the system to enable determination of the system effectiveness (20), and was further utilized for system debugging during initial development.

Data Generation Model

To enable efficient testing of the MDCS and to eliminate unnecessary data collection by the ROKAF, a data generation model was seen as the most effective method of obtaining data in the quantity and variety necessary to validate the system. The system flowchart of this generation model is shown at Figure 3. The model generates four basic types of data:

a. quality control data,

b. "delete" data,

c. direct labor data (aborts, failures, and depot manhours), and

d. manhour reporting data (indirect labor).

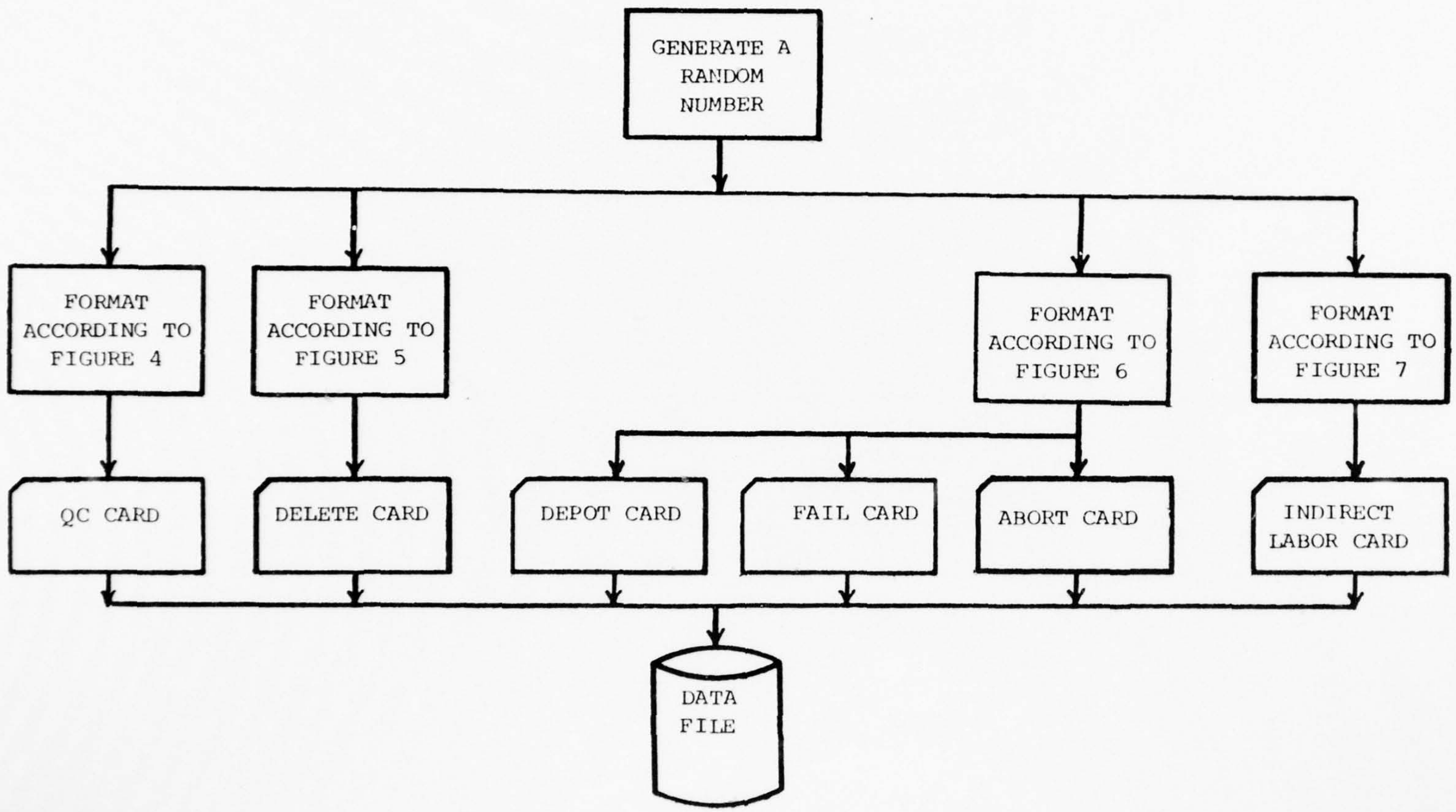

Figure 3. Data Generation System Flowchart

The format utilized for each of these cards is shown at Figures 4, 5, 6, and 7 respectively; for the latter two formats data is provided (in the real world) from AF form 349. An example of AF form 349 is shown as Appendix B. Air Force Manual 66-1 specifies that the 349 is the appropriate document for the collection of maintenance data on major weapons systems, and this form is currently in use by the ROKAF; the information generated is available on these forms.

Data Validation

Actual data from the ROKAF was checked against that generated by artificial means through the CREATE facility to ensure compatibility--further discussion of this subject will be left to Chapter IV as validation of the MDC system. Suffice it to say at this stage that the artificially-created data was used in initial validation of the reports generated by the system based upon congruence between the real and the artificial data.

Data Input

For the purposes of later utilization of the data input capacity, data can be input to computer disc storage in any of the following ways:

a. directly from computer interaction,

b. through remote terminals, or

c. through batch systems.

Card Column	Information	Character Type	Example
1 - 5	Inspection Type	Alphanumeric	5AGE
6	Blank		
7 - 8	Daily Progressive Inspection Number by Inspection Type	Numeric	03
9	Blank		
10 - 14	Julian Date and Year	Numeric	13277
15	Blank		
16 - 22	Mission Design Series	Alphanumeric	bRF004C
23	Blank		
24 - 28	Work Unit Code	Alphanumeric	12345
29	Blank		
30 - 31	Number of Discrepancies on This Inspection	Numeric	12

Figure 4. Quality Control Card Input Format

Card Column	Information	Character Type	Example
1 - 12	Blank		
13 - 20	Airport Serial Number	Alphanumeric	RF004C06
21	Blank		
22 - 27	Delete Instruction	Alpha	Delete (Always)
28	Blank		
29 - 35	Mission Design Series	Alphanumeric	bRF004C

Figure 5. Delete Card Input Format

Card Column	Information	Character Type	Example
1 - 3	Julian Date	Numeric	365
4 - 7	Job Control Number for each Work Center	Numeric	0021
8 - 12	Work Center	Alphanumeric	K3110
13 - 20	Aircraft Serial Number	Alphanumeric	bF004D20
21 - 27	Blank		
28 - 34	Mission Design Series	Alphanumeric	bbF004E
35 - 42	Blank		
43 - 48	Engine Number (when appropriate)	Alphanumeric	ABC123
49 - 52	Blank		
53 - 57	Work Unit Code	Alphanumeric	33333
58	Blank		
59	When Discovered Code:	Alphanumeric	
	(i) Depot Maintenance,		S (always)
	(ii) Abort, or		A or C (always)
	(iii) Failure		Any other alpha
60 - 62	How Malfunctioned Code	Numeric	950
63 - 64	Blank		
65 - 68	Starting Time on Job	Numeric	0820
69 - 71	Shift Indicator	Numeric	196
72 - 75	Finish Time for Job	Numeric	1715
76	Crew Size	Numeric	2

Figure 6. AF Form 349--Direct Labor Reporting Input Format

Card Column	Information	Character Type	Example
1 - 3	Julian Date	Numeric	136
4 - 7	Control Number	Numeric	0000 (always)
8 - 12	Work Center	Alphanumeric	WKCN4
13 - 15	Blank		
16 - 20	Manhour Report Identification	Alpha	INDLB (always)
21 - 52	Blank		
53 - 57	Type of Manhour Report	Alpha	LVEOV
58 - 64	Blank		
65 - 68	Starting Time	Numeric	0800
69 - 71	Indication of Shift	Numeric	123
72 - 75	Finishing Time	Numeric	1700
76	Crew Size	Numeric	6

Figure 7. AF Form 349--Indirect Labor Reporting Input Format

For purposes of validation of the system, data was stored to disc files and directly accessed by the system. Once the system is in use by the ROKAF it is anticipated that punched cards will be the applicable input medium; no conflict is foreseen in the different methods of input utilized.

Permanent Files

To augment the data files created through artificial means, the MDC system also requires the establishment of a number of permanent files for access by the model. The artificial data input to these files has been verified as realistic by the TCG (20). The typical information resident in these permanent files is:

a. the representative salary for each rank--to be used in the Manpower Accounting Summary for costing of the three categories of labor;

b. the authorized and assigned manning for each work center--also for manpower accounting computations;

c. lists of nomenclature for work unit codes--to be used in output formats to enhance readability;

d. authorized numbers of manhours for overhaul of aircraft types at the depot--for use in the Production Summary report; and

e. a file of the julian date which corresponds with initialization of end of month reports.

These files were created for purposes of interaction with the system to obtain meaningful output.

Explanation of AF Form 349 Inputs

As an insight into some of the terms used in the next section of this chapter, the following data elements appearing on the AF form 349 are explained:

a. malfunction codes--used to describe the reason for a malfunction;

b. work center designators--used to identify that work center which performed the requisite maintenance on the malfunctioned component/assembly;

c. work unit codes--used to define the maintenance action required to repair/replace the malfunctioned component;

d. when discovered codes--the method by which the malfunctioning component was isolated (abort, failure, etc.);

e. mission design series (MDS)--the type of weapons system which was the subject of maintenance; and

f. identification/serial numbers--unique identifiers for each MDS, in this case also known as tail numbers.

Description of the Output

A review of Figure 2 will show the outputs generated by the MDC system. The outputs will be dealt with as four subsections:

a. a quality control output:

   (i) QC output per type of inspection; and

   (ii) QC output per WUC;

b. failure/abort output:

   (i) number of aborts per WUC,

   (ii) number of failures per WUC,

   (iii) manhours expended per WUC, and

   (iv) failure rate summary;

c. production summary output;

d. a manpower accounting summary for each base.

Each of these reports will be dealt with in general, and some insight will be given as to the computer routines and algorithms utilized.

Quality Control Output

The aim of the quality control output is to identify significant deviations and trends in the number of discrepancies discovered during quality control inspections. A plot of current inspection results against past inspection results (in accordance with the flowchart at Figure 8 and in the format shown at Figure 9) will show if trends in discrepancies are developing and thereby permit early action to be taken to prevent shortages of spares through subsequent includion of additional requirements in the next year's Special Support Agreement. The output has two formats:

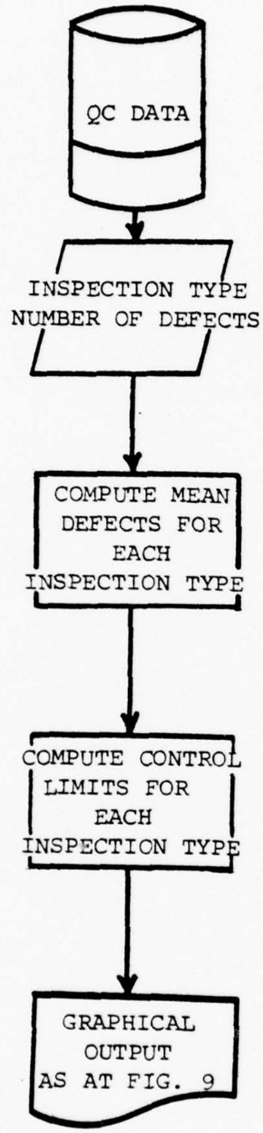

Figure 8. Quality Control Output Flowchart

QUALITY CONTROL OUTPUT
PER TYPE OF INSPECTION

TYPE OF INSPECTION

NUMBER OF INSPECTIONS THIS MONTH

TOTAL NUMBER OF DISCREPANCIES

RATE (DISCREPANCIES/INSPECTION)

	J	F	M	A	M	J	J	A	S	O	N	D
UCL												
$\bar{C}$												
LCL												

Figure 9. Quality Control Output Per Inspection Format

a. the graph of QC output per type of inspection to identify significant trends in the number of discrepancies discovered on each inspection--this graph is presented in the form of a control chart as Figure 9; and

b. a tabular presentation showing the total number of failures for each work unit code without reference to the type of inspection--this enables management to isolate the types of components that require special attention. The applicable flowchart is Figure 10 and format is shown at Figure 11.

The object of control charts (as illustrated in Figure 9) is to:

> . . . determine if variations in a product dimension are random and to detect assignable variations. The control chart is based on a series of samples of subgroups of items drawn randomly from a process over a period of time [4:319].

In this section we are dealing with a "defects per unit time" situation as it refers to the inspection process. Given this premise the control chart should be based on the Poisson distribution; that is, it is believed that there are few discrepancies discovered over a large number of observations. The Poisson probability distribution is a mathematical model with properties suitable for expressing this type of problem: small number of occurrences of a large number of observations (5:171). Applying this function to a control chart results in the use of the formula:

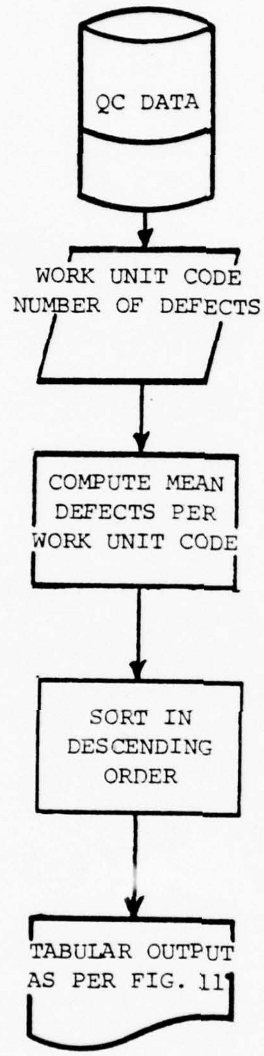

Figure 10. Quality Control Output Per WUC Flowchart

QUALITY CONTROL OUTPUT PER WORK UNIT CODE			
WORK UNIT CODE	NOMENCLATURE	NUMBER OF DISCREPANCIES	PERCENTAGE OF ALL DISCREPANCIES

Figure 11. Quality Control Output Per WUC Format

$$P(c) = \frac{\mu^c e^{-\mu}}{c!}$$

where c = the number of defects per inspection unit, and

μ = the expected number of defects.

The flowchart for manipulation of the data is found in Figure 8. The control limits of the chart will be the mean of all of the data, plus and minus three times the standard deviation of the number of defects:

$$\mu \pm 3\sigma_c$$

and the estimates of the control limits are:

a. upper control limit = $\bar{c} + 3\sqrt{\bar{c}}$, and

b. lower control limit = $\bar{c} - 3\sqrt{\bar{c}}$.

For this formulation

$$\bar{c} = \frac{1}{k}\sum_{j=1}^{k} c_j \qquad (14:207).$$

where k is the number of QC inspections for the last ninety days.

Failure/Abort Output

In order to be able to support the ROKAF it is necessary to develop a system of ranking items by their failure rates. Simple application of USAF failure rates has been found to be ineffective because of the differences

in types of missions flown,[2] differing climatic conditions, differing mission objectives, etc. Thus, the ROKAF needs to have reliable data concerning their own failure rates.

One objective of this subsystem of the MDCS is to rank items from highest to lowest according to the number of failures experienced within the past month (refer to the flowchart on Figure 12 and the format on Figure 13).

The information on failures is obtained from the failure data, as well as the data from depot overhaul functions. Concomitant to the output of failure rates it is necessary to delimit those items of equipment which have caused missions to be aborted; this information is presented as the Number of Aborts per WUC report. The applicable flowchart is shown as Figure 14 and the output format as Figure 15. The output utilizes information obtained from the abort data file and ranks the WUC by the number of mission aborts per month.

The system merges the data from the data bases (failures, aborts, and depot overhaul information) to produce the Manhours Expended per WUC report; the applicable flowchart is shown as Figure 16 and the output format as Figure 17. This information highlights those work unit codes that have utilized an inordinate number of manhours

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[2] With the F-4, the ROKAF tends to fly a large number of short missions each day, compared to a relatively different type of mission by the USAF. This results in differences in failure items; e.g., higher failure rates of tyres per hour flow for ROKAF aircraft (20).

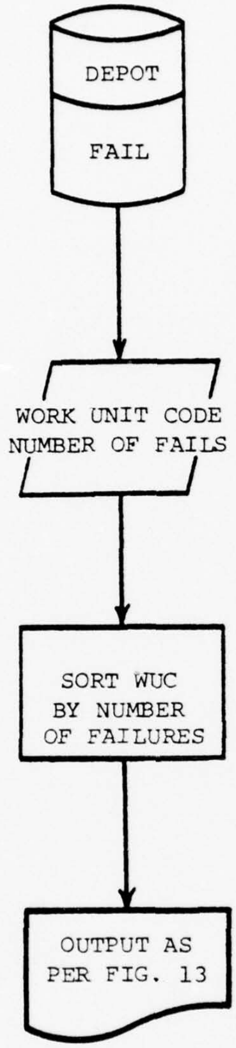

Figure 12. Failures Per WUC Flowchart

NUMBER OF FAILURES			
RANK	WORK UNIT CODE	NOMENCLATURE	NUMBER OF FAILURES

Figure 13. Failures Per WUC Format

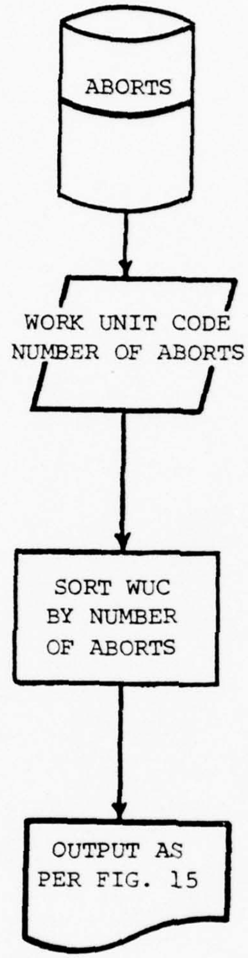

Figure 14. Aborts Per WUC Flowchart

NUMBER OF ABORTS			
RANK	WORK UNIT CODE	NOMENCLATURE	NUMBER OF ABORTS

Figure 15. Aborts Per WUC Format

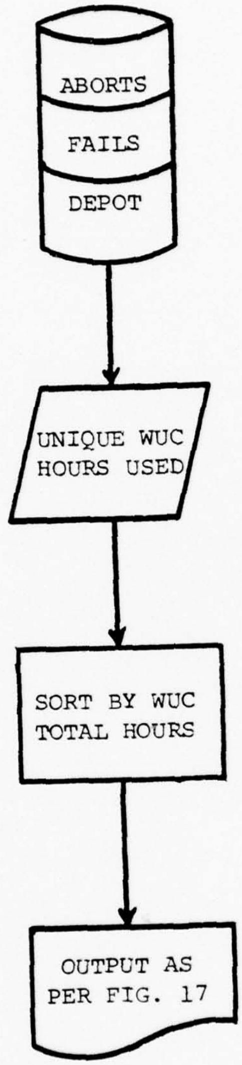

Figure 16. Manhours Expended Per WUC Flowchart

MANHOURS EXPENDED			
RANK	WORK UNIT CODE	NOMENCLATURE	TOTAL MANHOURS

Figure 17. Manhours Expended Per WUC Format

in the maintenance function and hence which may require some managerial attention.

In addition to the above outputs, the system also provides a comparison of all rates (failure, abort, manhours consumed) for the current and the previous month for all work unit codes. This quickly highlights those items that are requiring excess maintenance attention (through manhours expended), those that have caused the greatest disruption to operations (through number of aborts), and those with the highest failure rates (and therefore requiring priority inclusion in the following years SSA). The applicable flowchart is shown as Figure 18 and the output format as Figure 19. The comparison with the previous months data permits ROKAF management to detail those items which show a tendency to increase their relative importance, and hence require greater managerial attention.

Production Summary Output

The production summary is used to identify manhours utilized against those authorized for each weapons system (F-4) undergoing maintenance. From the ROKAF an authorized standard time (for each aircraft type requiring maintenance) has been obtained (from the TCG at Hill AFB) and actual time expended will be compared to highlight those aircraft which have overused manhours, as well as those which still have manhours available for usage. The program flowchart

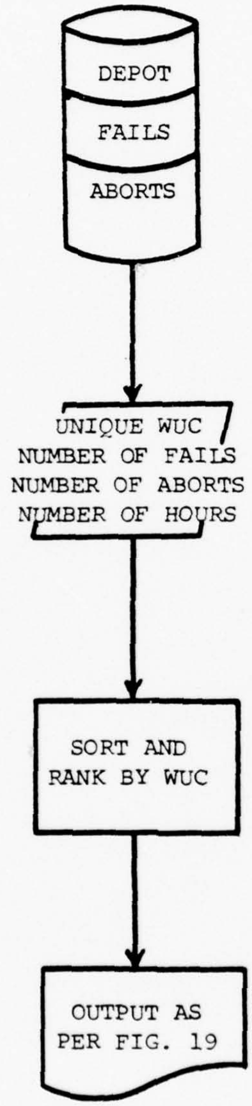

Figure 18. Failure Rate Summary Flowchart

FAILURE RATE SUMMARY													
		FAILURES		RANK		ABORTS		RANK		MANHOURS		RANK	
WORK UNIT CODE	NOMENCLATURE	LAST MONTH	THIS MONTH	LAST MONTH	THIS MONTH	LAST MONTH	THIS MONTH	LAST MONTH	THIS MONTH	LAST MONTH	THIS MONTH	LAST MONTH	TIME MONTH

Figure 19. Failure Rate Summary Format

to be used is outlined in Figure 20. After output of the report the delete file is used to perform file maintenance.

Once the actual manhours utilized for maintenance are obtained for a specific aircraft tail number, these can be compared against the number of hours authorized for that maintenance task and the difference specified. In addition, the percentage of authorized manhours still remaining to be expended will be displayed on the output to enable ROKAF maintenance managers to isolate instances where aircraft are likely to consume excessive maintenance time; this will identify problem areas before they occur, thus enabling correction by schedule adjustments. The Production Summary format is illustrated in Figure 21.

Manpower Accounting Summary

The ROKAF will utilize the MDCS to allocate men to those work centers which have shown a workload indicating a requirement for extra personnel (20). Despite a common misconception, the ROKAF has a shortage of manpower; in the last two years there has been a 25 percent increase in their workload without offsetting increase in authorized manning (20). Hence, for the ROKAF to operate efficiently they must have the capability to effectively reallocate the manpower authorizations that they presently have established.

Figures on manpower usage will be subdivided into "direct," "indirect," and "other" classifications (the

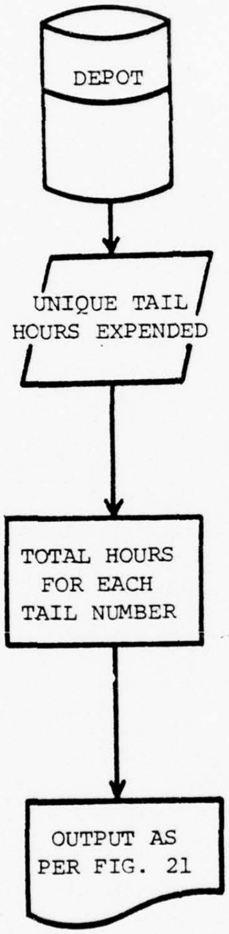

Figure 20. Production Summary Flowchart

PRODUCTION SUMMARY FOR (BASE)					
MDS	SERIAL NO.	M/H USED	M/H AUTH.	M/H LEFT	M/H OVER

Figure 21. Production Summary Output Format

latter to account for times for which no AF form 349 has been submitted); this report facilitates justification for manpower authorization increases, as well as bringing under maintenance managers' scrutiny inordinate times spent on particular maintenance activities (refer to Figure 22 and Figure 23 for the MDCS flowchart and the programmed output, respectively). These figures will be presented for each work center; further, the output will show a comparison of manning authorized against assigned manning for each of the work centers.

Overview

This chapter has given an overview of the elements of the model, together with some discussion of the development of the maintenance data--further development of the data will be discussed in Chapter IV under Validation of the Model. The next chapter will give some insight into the development of the model, together with more detailed analysis of the actual subroutines utilized.

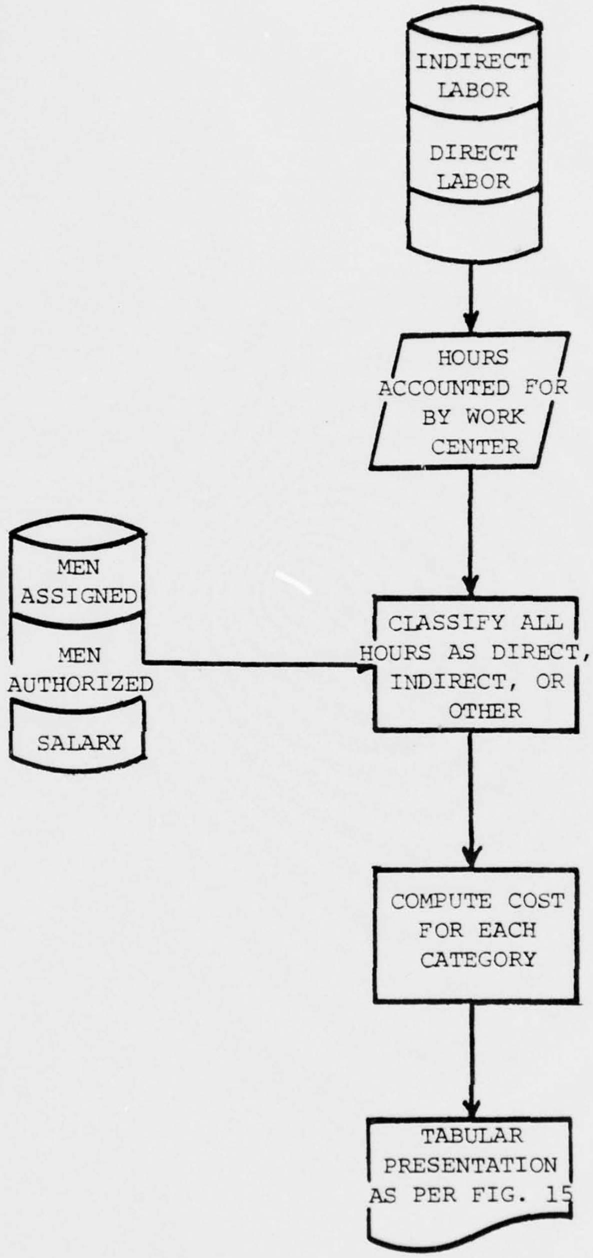

Figure 22. Manpower Accounting Summary Flowchart

MANPOWER ACCOUNTING SUMMARY PER WORK CENTER									
WORK CENTER	DIRECT LABOR		INDIRECT LABOR		OTHER		AUTHORIZED MANNING	ASSIGNED MANNING	PERCENT MANNED
	Manhours	Cost	Manhours	Cost	Manhours	Cost			

Figure 23. Manpower Accounting Summary Format

CHAPTER III

DEVELOPMENT OF THE MODEL

The purpose of this chapter is to give some detailed insight into the actual model developed to fulfill the research objectives outlined in the first chapter. This chapter will be dealt with as two distinct sections: the first will consider the algorithm utilized to develop an extensive data base; the second section will give a detailed account of the model developed to manipulate the data and then provide information on the form of the outputs specified in Chapter II.

Data Generation

At the time that the model was in the developmental stage, no data was available from the ROKAF to enable testing of the model. Further, in the light of the amount of time necessary to collect and input data for a year of maintenance activity, it was decided that the most efficient means of model validation would be to develop an algorithm to generate "artificial" data of sufficient variety to test all aspects of the model in accordance with current Air Force manuals (28; 29). A high level flowchart of the program developed for data generation is shown as Appendix C; the actual program is shown at Appendix D. Each of the

subroutines of the data generation program will now be discussed in some detail to support our later contention that the validated model was realistic in all respects.

Air Force Form 349 Input

For each maintenance activity within each work center, an AF form 349 is submitted to account for manhours expended on some specified maintenance function; these forms are also input to record elements of indirect labor, such as leave, detailed duty, alternative duty, etc. The remaining time not thereby accounted, such as lunch breaks, coffee breaks, etc. is determined from the differences between total time accounted for as "direct" or "indirect" labor, and the total time available for each work center; this element of manhour accounting is classified as "other."

Through the submission of AF form 349, one of four situations is designated:

a. a mission abort has occurred,

b. there has been a failure of some sort,

c. there has been manhour usage at a depot, or

d. indirect labor usage has been recorded.

Each of these four situations will now be discussed.

Mission Abort. It is of obvious necessity that a MDCS should produce detailed information of the occurrences of mission aborts as this is a most significant form of mission failure. When a mission abort occurs, the

resultant AF form 349 submitted will show a "when discovered code" as an "A" or a "C" in card column 59 of the data input. The model will use this input in the production of the abort report.

Normal Failure. There are a number of occasions when a failure will be detected in aircraft performance which does not result in a mission abort; such a failure is designated through the use of any alphabetic character in card column 59, except for "A", "C", or "S." Nowhere in the model do we require detailed knowledge of the type of failure, merely information to the effect that a failure did occur. Hence, for the purposes of data generation only two alphabetic characters were utilized to designate a failure: "B" or "F." This does not represent a limitation because complete variety in input is represented through mere indication of the existence of a failure. At some later date, through further development of the model, there may be a requirement to expand the capacity of this element of the data generation algorithm. This can be easily effected through minor alteration of the program but no purpose is served thereby at this stage.

Depot Maintenance. Each aircraft is scheduled into the depot for some form of major overhaul at irregular intervals, the exact frequency of this occurrence is unimportant--what is important for the purposes of our

model is a record of the number of manhours actually used in overhaul activities conducted at the depot, and the number of hours authorized for completion of that type of overhaul. Reference to card column 59 will determine whether the AF form 349 was submitted to record depot level maintenance--an "S" indicates this fact. Because the output requirements at Chapter II do not necessitate differentiation between types of overhaul, such a facility has not been incorporated in the data generation program--the algorithm merely generates a number of hours work on a particular aircraft without discriminating between types of overhaul. This is not viewed as a limitation of the program.

Indirect Labor Usage. Each work center manager has a requirement to account for the available work time of his employees--through the input of hours for indirect labor the manager is able to exercise more effective supervision of the activities of the members of the work center. A blank in card column 59 indicates that the input is in the form of an indirect labor usage card; for the purposes of the model there is little need to generate a great variety of types of indirect labor. In the case of this exercise we have generated five different types of indirect labor even though none of the outputs of the model require detailed knowledge to this extent, merely information to

the effect that the card deals with indirect labor is quite sufficient. The types of indirect labor utilized are:

a. alternative duty : ALTOO

b. compensatory time : CMPOO

c. detail duty : DTLOO

d. leave : LVEOV, and

e. training : TRNOO

In some later development of the model there may be a need for a more detailed breakdown of the indirect labor--the data generation program can easily be amended to accommodate this new requirement.

Apart from the differentiation required amongst the types of reports as indicated at card column 59, the remaining sections of AF form 349 are of much the same format except for the differences in the indirect labor input. To complete discussion of the AF form 349 input, the remainder of this subsection will differentiate according to whether the input card is for purposes of recording indirect labor or not. To effect this discussion, all elements of the AF form 349 will be defined.

Job Control Number. The job control number is a seven-digit field consisting of two elements: the julian date (three digits) followed by the actual job control number (four digits). For each work center a job control

number counter is initialized for each julian date. The facility to uniquely identify each input card is not a requirement of the model but has been incorporated in the data generation program to add realism. The only difference between direct and indirect labor inputs is that the latter does not require a job control number, but only the inclusion of the julian date (the area designated for issuance of a job control number is left blank).

Work Center. The work center consists of a five-character alphanumeric field in card columns 8 to 12 to uniquely identify that work center which raised the AF form 349, and hence which completed the work shown on that form. For the purposes of data generation we have isolated five work centers from ROKAF data and created one depot--we believe that this will present sufficient variety to validate this aspect of the model. The five work centers and depot are indicated as:

a. work center K3110,

b. work center K4140,

c. work center K3160,

d. work center K4110,

e. work center K4230, and

f. the depot DEPOT

Aircraft Serial Number. In most cases the aircraft serial number will be the tail number of the aircraft upon

which maintenance is being effected. We have allowed for an eight-character alphanumeric field in card columns 13 to 20 to record this tail number. For model validation it has been assumed that there are 20 tail numbers (from 01 to 20) for each of the four aircraft types. In the case of indirect labor, the generation of the label "INDLB" will appear in place of an aircraft serial number.

Aircraft Type. The aircraft type is recorded in card columns 28 to 34 as a seven-character alphanumeric field. The ROKAF has four different aircraft types for which this program generates variety: F-4C, F-4D, F-4E, and RF4-C. This output is in consonance with the ROKAF situation but would necessitate further modification if the model is later expanded to incorporate other aircraft types. For the purposes of this thesis, this limited variety of aircraft type is not viewed as a limitation. In the case of an input of indirect labor information, this field remains blank.

Engine Identification. This six-character alphanumeric field is recorded in card columns 43 to 48; an input will only occur here when the work conducted under the AF form 349 is in respect of an aircraft engine. Nowhere in the model is this information referenced and hence no variety is necessitated: when an engine is worked

upon, the field will show "ABC123;" obviously the field will remain blank for the input of an indirect labor data.

Work Unit Code. The work unit code specifies the type of work that is conducted on the aircraft for this particular AF form 349. Reference to current regulations [i.e., Technical Order (T.O.) IF-4E-06 (27)] will show a multitude of different codes to fill this five-digit field; for the purposes of variety generation it was decided that ten different codes would represent sufficient diversity to validate the model. The algorithm can easily be changed to reflect a greater variety but little purpose would be served thereby. In the case of indirect labor, this field will indicate the type of indirect labor discussed, five different labor inputs are utilized but no later use is made of this fact in the model so further variety is not necessary and the diversity in existence only serves to add realism to the data so generated.

When Discovered Code. This one-character alphanumeric field in card column 59 has already been discussed as the determinant of the type of input generated by the AF form 349.

How Malfunctioned Code. This three-digit field in card columns 60 to 62 is used to indicate the cause of the malfunction (blank in the case of indirect labor input).

There is an allowance here, by T.O. IF-4E-06 (27), for 1000 different malfunction codes but 10 were considered to represent sufficient variety for model validation. Further codes could be developed if the need arose but the utilization of only 10 is not considered to be a limitation of this model.

Commencement Hour. At the time that work starts on the task shown by the AF form 349, such time is recorded to enable management to establish how many manhours were spent on each particular job. This procedure also applies in the case of indirect labor input to account for unproductive manhours. This information is recorded in card columns 65 to 68 as a four-digit field based on a 24-hour clock.

Shift Indication. In the event that a job is commenced on one julian date but the crew so engaged continues on that job past midnight, card columns 69 to 71 record the julian date that the job terminated in order to facilitate later computation of manhours worked. This input becomes particularly relevant for shift work.

Finish Hour. This element is of the same format as the commencement time but recorded at columns 72 to 75; likewise it is utilized to compute manhour accounting.

Crew Size. This one-digit character in column 76 is used to record the number of persons working on the task specified on AF form 349. The algorithm generates from one to seven persons--greater variety can be generated through amendment of the algorithm (and incorporating changes to the model) but it is considered an unlikely event that more than seven persons would be employed upon any one task. This element is not seen as a limitation to the model.

Quality Control Input

After each aircraft has left the work center or depot at the end of maintenance, quality control inspectors conduct a number of tests in the area that has been subjected to repair. There are a number of different quality control inspections that are conducted, but the objective of each is to discover how many discrepancies have not been alleviated by the maintenance function. The number of discrepancies so discovered will be utilized in the production of quality control charts to enable ROKAF management to discover trends in maintenance performances, and thereby to act as a control over the quality of the maintenance function. Each of the elements of the quality control input generation will now be discussed in detail.

Inspection Type. In card column one to five is a five-character alphanumeric field to record the type of

inspection conducted. For the purposes of data generation five different inspection types were utilized to produce sufficient variety to test the model; these inspection types are denoted:

a. BPE,

b. BPO,

c. 5AGE,

d. QDI, and

e. QUI.

Once again, modification of the algorithm could result in the generation of increased variety, but such a course of action was considered unnecessary.

Inspection Number. Card columns seven and eight record the serial number of each inspection type for each calendar year. No use is made of the serialization of these inspection numbers within the model; however, the inspections are serialized to lend authenticity to the data so generated.

Julian Date and Year. The julian date and year enables the inspections to be input to the model in day sequence--this will facilitate later inspection of trends. The julian date is a three-digit field commencing in card column 10; the remaining two digits are obtained from the last two digits of the year; they are recorded starting in column 13.

Aircraft Type. This seven-character alphanumeric field is found in card columns 16 to 22. For the purposes of this thesis it has been assumed that there are four different aircraft types available; little alteration is required to increase this variety but to little purpose for the development of the model.

Work Unit Code. As explained in the previous subsection, this code is used to show what work was being performed upon the aircraft. It has been assumed that there are ten different codes.

Number of Discrepancies. This two-digit field indicates the actual number of discrepancies found upon the quality control inspection--the number is generated through a random number generator which produces a Poisson distribution with a lambda value specified by the random number so generated. This process would appear to be a reasonable approximation of the situation encountered in most quality control situations.

Production Summary Delete Card Input

The final product of the data generation algorithm is the production of a delete card. This card is input to the model to perform updating of the Production Summary data file after aircraft have left the depot at the cessation of all maintenance necessary for the particular

overhaul under discussion. Once this card is produced the model will cease to compute a comparison of actual man-hours utilized against the number that is authorized for that aircraft. A more detailed discussion of this card follows.

Aircraft Serial Number. As previously explained, the aircraft serial number is a unique identifier of the plane and would usually be the aircraft tail number.

Deletion Input. If the word "Delete" appears in card columns 22 to 27, this fact is used to identify the production of a deletion card and enables the model to store and utilize this information accordingly.

Aircraft Type. Card columns 29 to 35 show the type of aircraft leaving the depot.

Input Formats

To enable a consolidated inspection of the input format, the details contained in the previous subsections have previously been summarized and appear in Chapter II, Figures 4 to 7. As an example of the product of the data generation algorithm, a typical output is shown as Appendix E.

Data Generation Limitations

For the purposes of data generation the following assumptions were made:

a. there were five work centers and one depot;

b. there were four aircraft types, and 20 different aircraft of each type;

c. no work center or depot worked on more than one aircraft each day;

d. there were only ten "work unit" codes, five "when discovered" codes, five types of indirect labor, ten "how malfunctioned" codes, and five different types of quality control inspections; and

e. a maximum of seven people worked on any crew.

None of these assumptions is considered to represent a sizeable constraint on the effectiveness of the data generated although perhaps there is cause for discussion as to whether one plane per shop/depot is realistic. In fact, this problem could have been alleviated but only at some great modification of the algorithm; in the light of time priorities it was decided that better utilization could be made of this scarce resource if allocated towards refinement of the model. However, despite this one limitation, we believe that the data generation represents sufficient variety to validate the model in preparation for the later tests with real data.

Anatomy of the Model

The previous section of this chapter dealt with the development of the data generation algorithm, which in

turn led to a detailed explanation of the format of the input to the model; further discussion of the format is not considered warranted. This section of the chapter will involve a discussion of the model itself, concentrating on how the input is manipulated to achieve the reports shown in Chapter II. Then the discussion will concentrate on the development of the MDCS, through further explanation of the subroutines involved. Figure 24 shows the model with the major elements highlighted. (Listings of all other routines are shown at Appendix N.) For edification, examples of each of the output reports are shown as appendices as follows:

a. Quality Control Output per Type of Inspection--Appendix F;

b. Quality Control Output per Work Unit Code--Appendix G;

c. Number of Failures per Work Unit Code--Appendix H;

d. Number of Aborts per Work Unit Code--Appendix I;

e. Manhours Expended per Work Unit Code--Appendix J;

f. Failure Rate Summary per Work Unit Code--Appendix K;

g. Production Summary--Appendix L; and

h. Manhour Accounting Summary per Work Center--Appendix M.

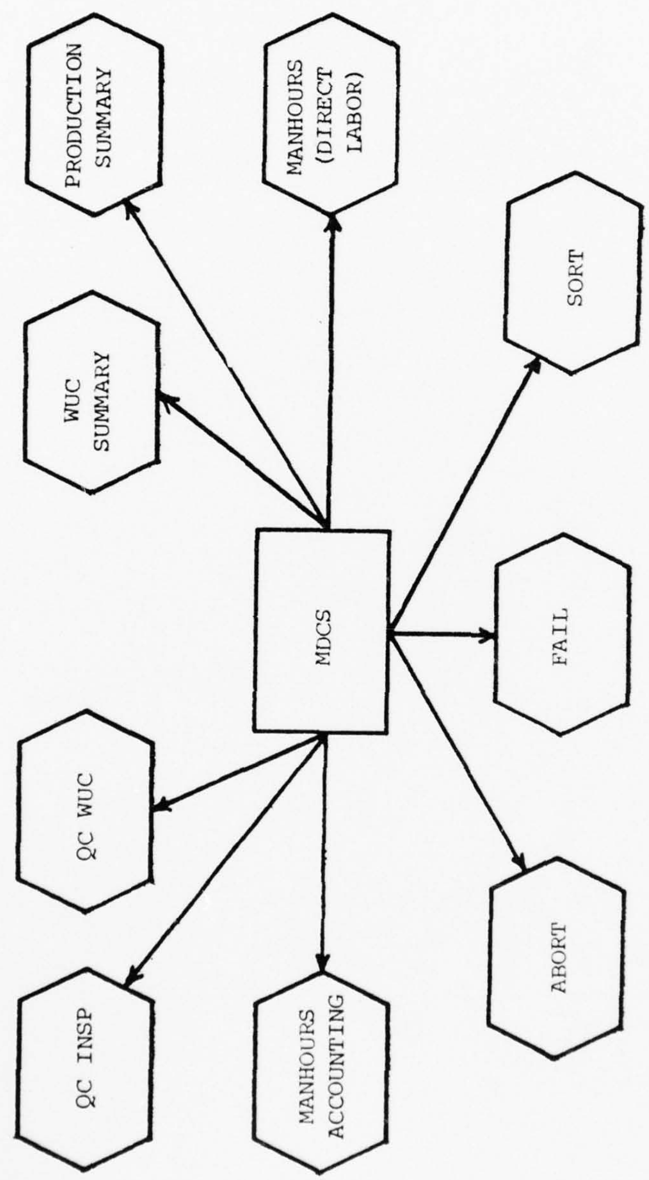

Figure 24. The MDCS Model--Major Routines

Each of the major routines involved in the output of these reports will now be discussed.

Main Program

Any cards may be input at any one time; that is, there is no requirement that the input be presorted to groups of AF forms 349, production delete cards, or quality control inputs. However, the model does require that the input be batched into julian date sequence--this requirement is necessitated by the need to initiate report procedures at the end of each month; this initiation is dependent upon the julian date appearing on the input.

Initial Sort Routine

The first routine observes the julian date to ensure that a monthly report is not required (refer to Figure 25 for the flowchart). The routine then sorts the input into six files:

a. summary delete cards,

b. manhour accounting inputs,

c. depot production control accounting,

d. mission aborts,

e. equipment failures, or

f. quality control cards.

Quality Control by Inspection Type Routine

The quality control inspection routine sorts through the quality control input cards to isolate unique

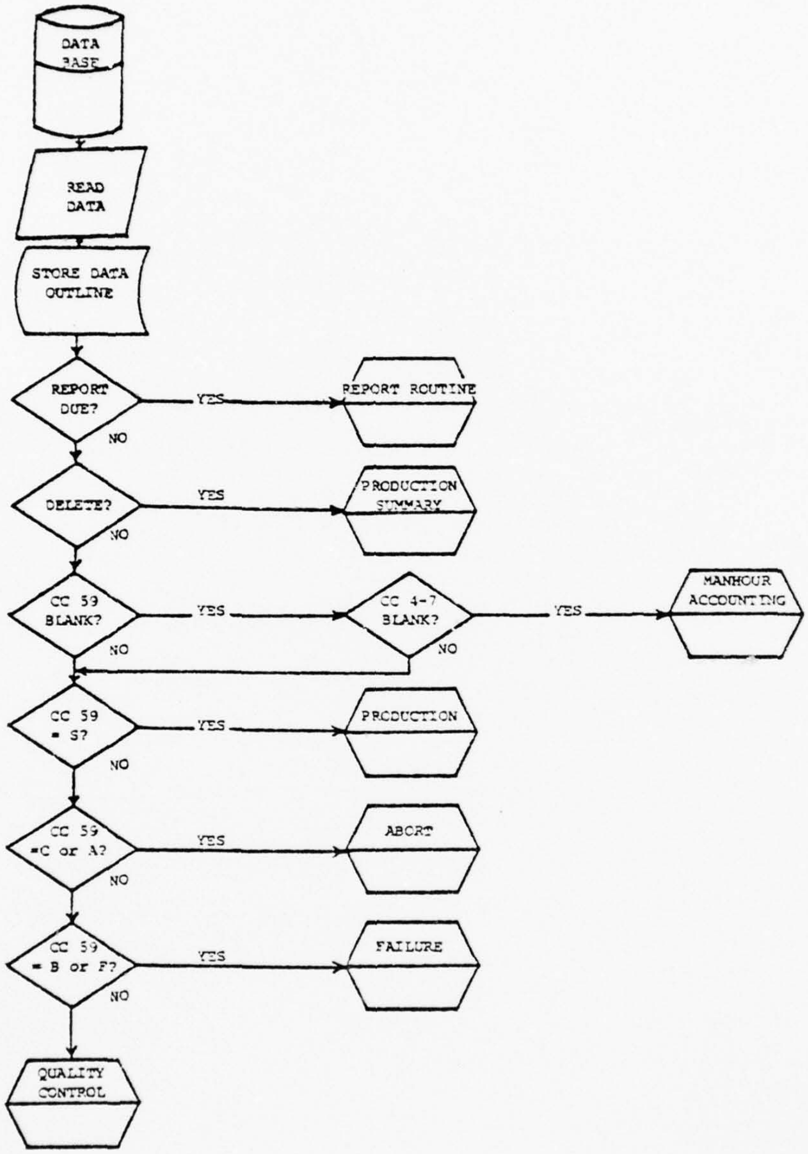

Figure 25. Initial Sort Routine

types of inspection. Then, for each type of inspection (there are five types generated by the data creation algorithm) the model keeps a cumulative total of the number of occurrences of such an inspection, together with a progressive total of the number of discrepancies recorded on each of these quality control inspections. This data is recorded in two counters:

a. one counter for the current month, and

b. another counter for the last three months.

The latter counter is used for purposes of comparison and to establish the limits on the graph of Quality Control Output per Inspection Type. This process is then repeated for each type of inspection and the resultant graphs and tables are produced in accordance with the flowchart depicted at Figure 26.

Quality Control by Work Unit Code Routine

This quality control routine then sorts the quality control file according to each work unit code within julian day limits. The objective of this output is to show in tabular form the number of discrepancies isolated for each of the work unit codes. This report is also output monthly, according to the logic flowchart shown at Figure 27.

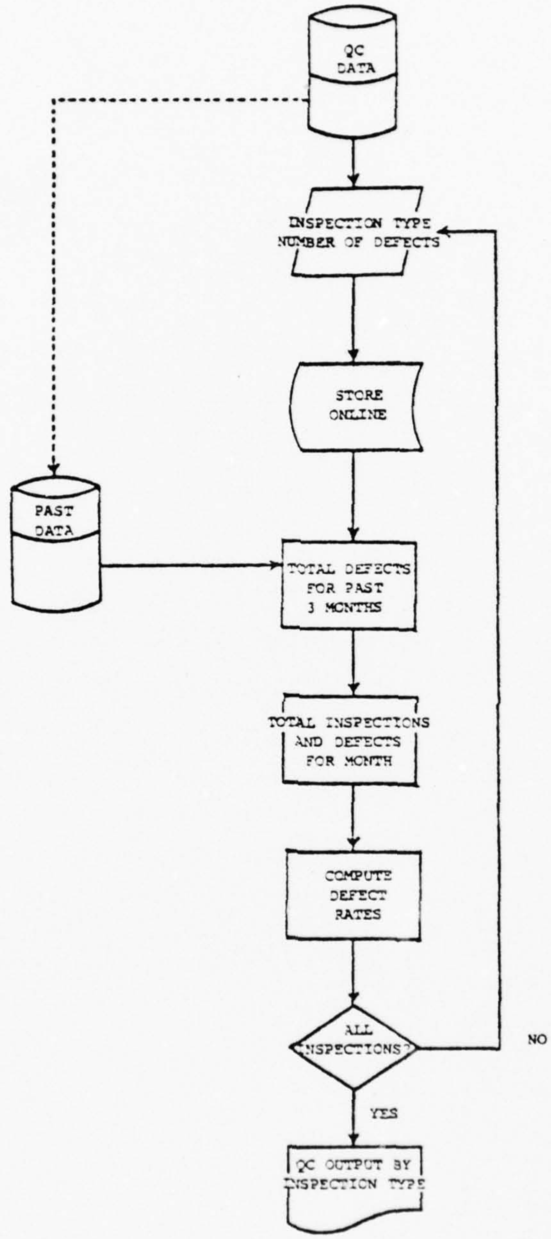

Figure 26. Quality Control by Inspection Type Routine

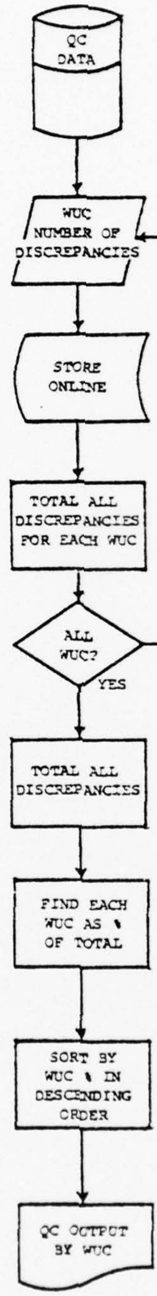

Figure 27. Quality Control Output by WUC Routine

Failure per WUC Routine

The object of this routine is to sort through the data base for all work centers and the depot to isolate information on all failures to enable compilation of a listing of the total number of failures for each work unit code. The total number of failures will determine the ranking assigned to each work unit code (WUC). The output is in descending order of occurrence. The flowchart is shown at Figure 28.

Abort per WUC Routine

This output is in much the same format as that of the equipment failure routine: the abort data base is read and mission aborts are sorted to each work unit code. The routine totals the number of aborts for each work unit code, sorts the WUCs according to total number of aborts for each code, then outputs the codes in descending order; refer to Figure 29 for the relevant flowchart.

Manhours Expended per WUC Routine

The manhours report is a composite listing of all direct manhours expended for each work unit code. This information is obtained from all AF form 349 data files which were raised in respect of failures, mission aborts, or depot level maintenance. The routine sorts the total manhours for each WUC and outputs them in descending order. The applicable flowchart is shown as Figure 30.

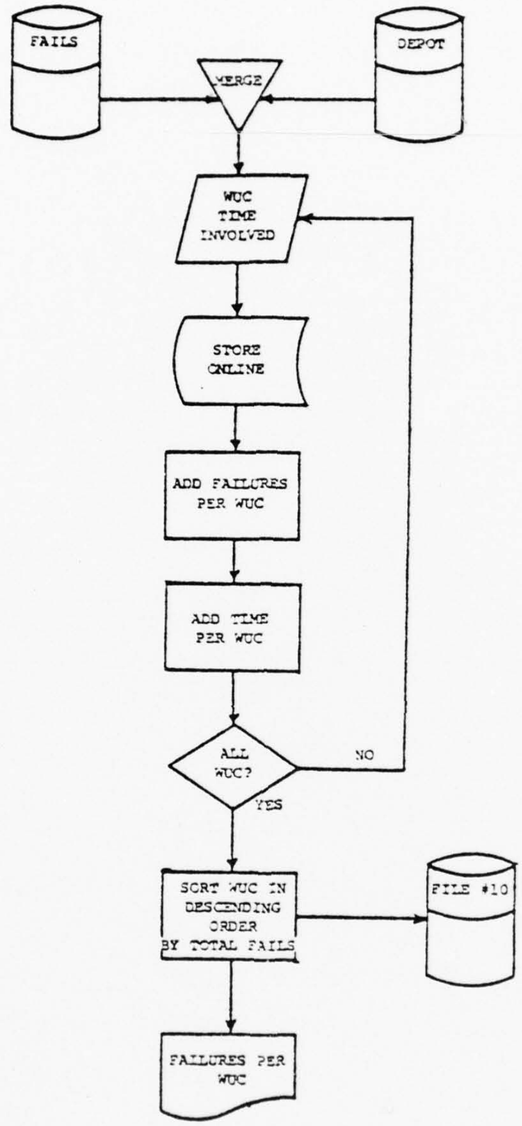

Figure 28. Failure Per WUC Routine

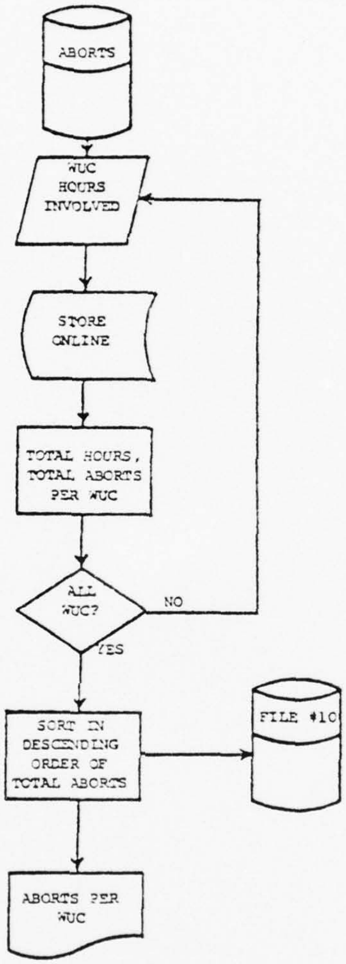

Figure 29. Aborts Per WUC Routine

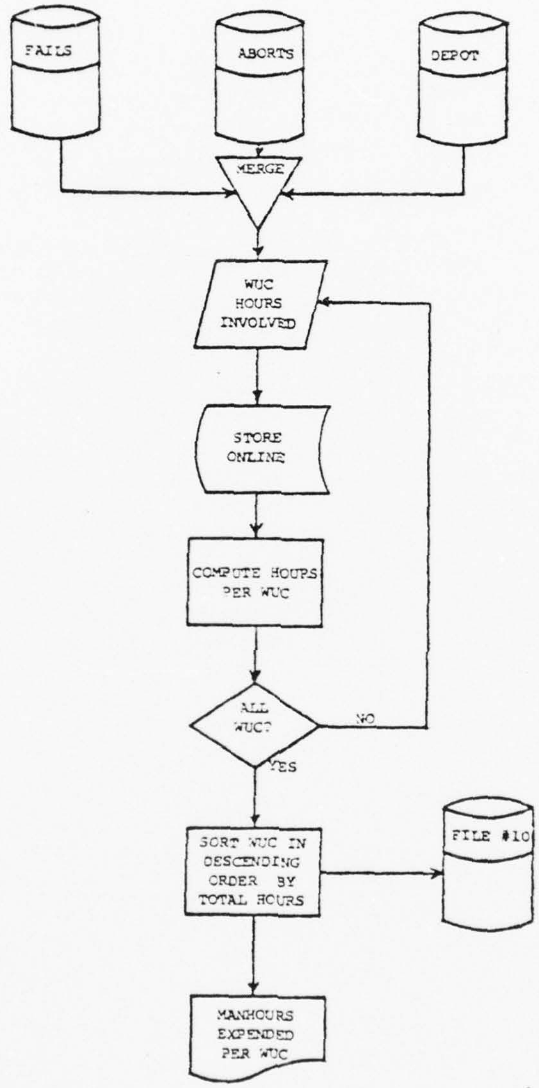

Figure 30. Manhours Expended Per WUC Routine

Failure Rate Summary Routine

The objective of this report is to output the number of failures, mission aborts, and manhours expended on the maintenance function for each work unit code; in effect, this report summarizes the outputs of the previous three reports but also accesses the previous months data for purposes of comparison and outputs the two sets of data for each code. The flowchart of this procedure is shown as Figure 31.

Production Summary Routine

The aim of this routine is to output a quarterly report showing the hours worked on each aircraft in the depot facility. The total hours worked are checked against the total hours authorized and discrepancies are highlighted. The applicable flowchart is shown as Figure 32.

Manpower Accounting Summary Routine

The final output is a summary of the manpower utilization per month for each work center under three headings: "direct labor," "indirect labor," and "other." The routine follows the logic of the flowchart shown at Figure 33 and shows the cost of each of the three manhour elements isolated. The output also shows the number of men assigned to each work center in comparison to the number of men authorized and computes a percent manned.

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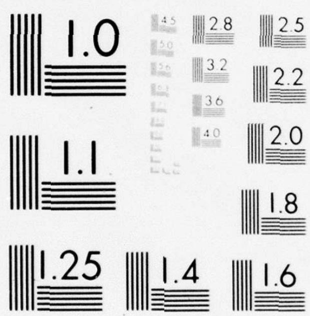


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

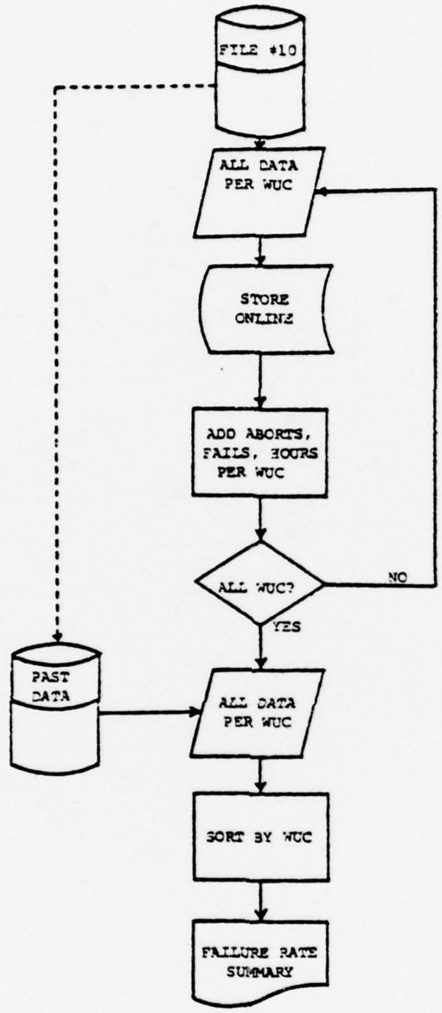


Figure 31. Failure Rate Summary Routine

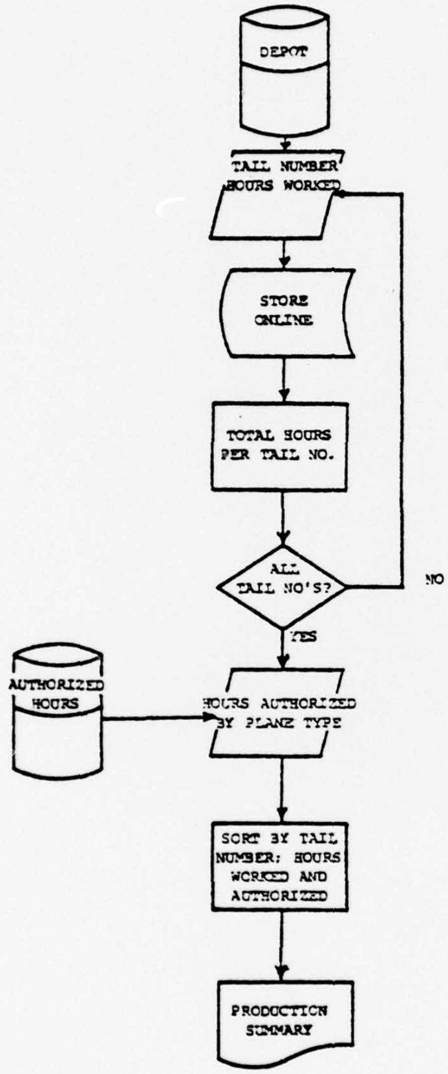


Figure 32. Production Summary Routine

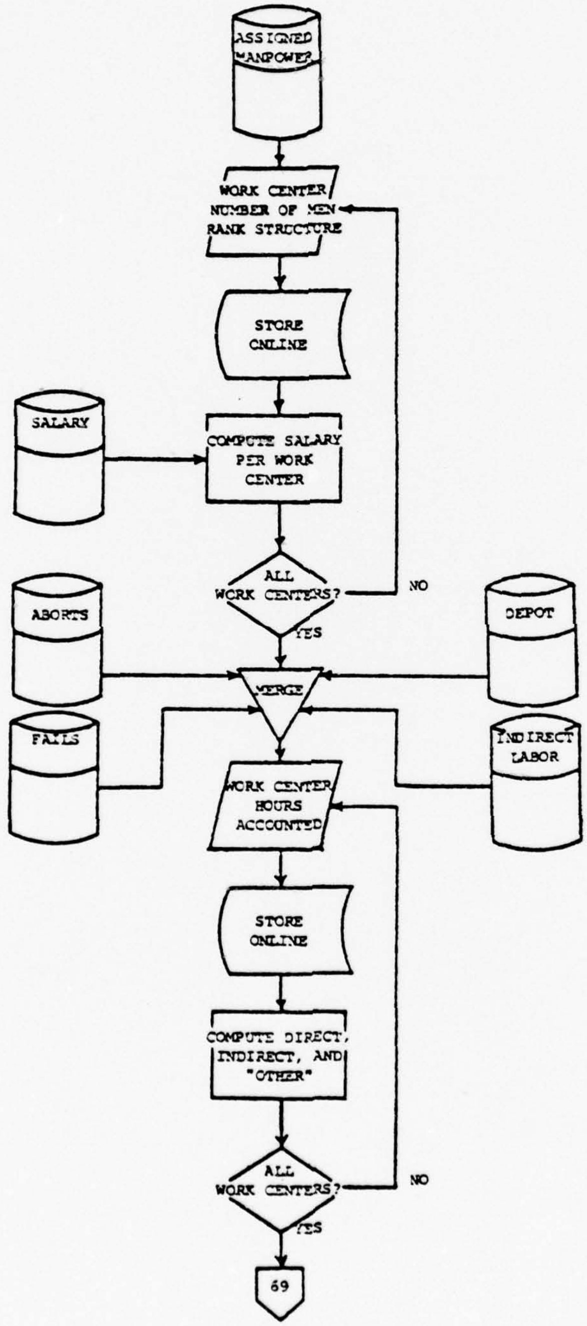


Figure 33. Manpower Accounting Summary Routine

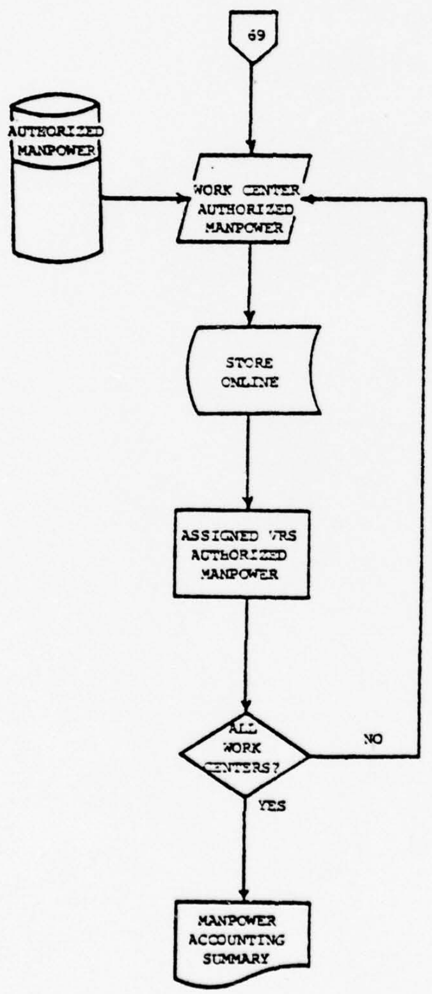


Figure 33--Continued

Summary

This chapter has developed each of the important facets of the model, showing elements of each of the subroutines utilized to obtain the final outputs. The next chapter will develop the validation of the model, concentrating on use of the "artificially" generated data as a substitute for actual data. The chapter will also discuss the outputs obtained in the light of the original requirements shown at Chapter II.

CHAPTER IV

VALIDATION OF THE MODEL

This chapter will deal with the validation of the model as two distinct sections:

a. validation of the use of generated data; and

b. validation and examination of the system outputs.

The third section of the chapter will analyze the times involved to produce the requisite outputs to test the research objectives posited in Chapter I.

Data Validation

AF Form 349

Reference to Appendix B shows a copy of AF form 349 which is used by the ROKAF to account for manhours expended on maintenance functions. The data recorded on this form has been generated by the data program in the format shown at Figures 6 and 7; each element of this input will now be examined.

Julian Date. The program generated one year of data so the capability to utilize 366 days of outputs has been tested. The model uses the julian date to initiate reports due monthly and quarterly; this aspect will be fully tested later in this chapter.

Job Control Number. The data generated includes the capability to increment a progressive job control number, starting at unity for each work center for each julian date. The ROKAF generates actual AF form 349s in this fashion for purposes of manpower and accounting controls. The model does not require that unique job control numbers be input as they are not used in any of the output reports; however, we believed that the model should have the facility to acknowledge the existence of the job control numbers for running checks on what may appear to be abnormal inputs--in this way the information stored on tape can be checked with the actual data.

Work Center. From data obtained from the ROKAF (22) we have selected five representative work centers for which data has been generated. We had no real data on a depot but created the manning for a depot to enable full testing of the model. This manning was based on Flight Line Support Branch manning figures (22). The model has the capability of outputting the requisite reports for as many work centers as exist in the ROKAF; however, to generate data for a large number of work centers was not considered worthwhile in the light of thesis time constraints. We believe that the selection of five work centers and one depot represents sufficient variety to test the capabilities of the model.

Aircraft Serial Number. The data generation program utilizes an eight-character combination of alphas and numerics to represent the tail number of each of the aircraft. In practice, the use of three numerals is sufficient to uniquely identify each of the F-4s used by the ROKAF, but the program generates a more complicated input to test the capability of the model to manipulate such an input format. The aircraft serial number is required to account for manhours expended on the maintenance function during overhaul at the depot--this is output as the Production Summary Report for each tail number.

Aircraft Type. The ROKAF currently uses four types of F-4--the program generates these four types with equal probability. As was explained earlier, twenty different tail numbers may be generated for each aircraft type for a total of 80 different aircraft tail numbers. In actuality, the ROKAF does not have exactly 20 of each aircraft type but the data generated represents a realistic approximation that satisfies the requirements for model validation. The model can recognize seven characters (both alphas and numerics) as representing the aircraft type; the data generation program fully tests this capability.

Engine Identification. The data generated for an engine number is fixed as "ABC123." Nowhere does the model use the engine number in the reports output so the facility

to generate variety was not incorporated as such a facility would have led to needless difficulties in effecting such an inclusion. The engine number has been allocated a field in the input format to add authenticity to the input, as well as to enable expansion of the model at some later date to incorporate reporting on engine maintenance. For the reports currently produced by the model, the engine identification is not required.

Work Unit Code. There are only ten work unit codes generated but they represent sufficient variety to test the capability of the model to manipulate this input. In fact, there are a great diversity of work unit codes (27) but to incorporate more than ten adds unneeded complexity. The nomenclature of the work unit codes is stored as a permanent file and accessed as needed for output reports to add clarity to those reports.

When Discovered Code. The data generated consists of the alphas "A," "B," "C," "F," and "S," or a blank. The "when discovered code" can take on any alpha, dependent upon the circumstances of the occurrence of a malfunction; whereas the real world will generate greater variety than the data program; this is not seen as a limitation to the realism of the artificial data. The model merely recognizes the input as a mission abort ("A" or "C"), an equipment failure ("B" or "F"), depot maintenance ("S"), or manhour

accounting (blank). At some later development of the model there may be a requirement for definition of more input types and this need can be met through the "when discovered code."

How Malfunctioned Code. This element is represented through the generation of ten different codes; in practice, there are up to one thousand different codes but we believe that ten represents sufficient complexity to validate the model. Besides, the reports output by the model do not require details of the malfunction code--the facility to generate the code has been incorporated to lend authenticity and to ensure that the input data utilized by the model has the facility for later utilization of this input should such a need arise.

Start Hour. The starting time is generated from a random number according to a specific distribution as shown in Appendix O. The times and probabilities chosen are entirely arbitrary and based solely on the authors' own experience. However, this distribution of starting times is not seen as a limitation because the data is used merely to test the model. It would have been possible to write a program to generate data for each person employed in each work center (and thereby eliminate possible start/finish time inconsistencies) but such a schedule would have resulted in an added authenticity which was not required

at the time cost that would have been necessary. The data generated is sufficient to test the capabilities of the model to manipulate hours worked on particular maintenance functions, as shown by the output reports.

Shift Indicator. The julian date is printed as an indicator that a work crew has been employed for a period of time that includes midnight--this input is necessary for manpower accounting purposes to enable correct recording of hours worked. This is an exact duplication of reality.

Finish Hour. The remarks made under the start hour are equally applicable here: the times were generated according to an arbitrary distribution shown at Appendix O. To lend authenticity to the data so generated, minutes for both start and finish time have also been included in the form of a uniform distribution. The model incorporates this data for manipulation of manhour data and the facility to use minutes in that data has been verified.

Crew Size. The crew size is also used for purposes of manhour accounting. The data generated will produce a crew size of from one to seven in accordance with an arbitrary distribution contained within the data generation program. The AF form 349 only permits recording of one digit of information on crew size which effectively places a maximum limitation of nine persons per task. The model

reflects this limitation. This is in consonance with reality in which a crew size usually does not exceed five; certainly in reviewing sample data from the ROKAF this was the situation. However, future modification of the model would permit the use of larger crew sizes up to a maximum of nine persons.

A sample of 200 AF form 349s has been received from the ROKAF to aid in data validation. These forms have been examined by the authors and no discrepancies were found between the type of data generated artificially and that actual data, with an exception in that the actual data incorporated greater variety than the artificial data. This limitation has been discussed above; suffice it to add that the real data verifies the generated data. The real data has not been run against the program because it is incomplete: these forms are from a variety of work centers and for various times and do not show sufficient time consistency for system validation. Therefore, it was decided to utilize the artificial data as a surrogate for the real ROKAF data.

<u>Quality Control Inputs</u>

The format of the quality control inputs has previously been shown as Figure 4; to recapitulate: the quality control input is used to record the number of discrepancies found on inspections of aircraft. Very little

actual data has been received from the ROKAF which would enable complete validation of the data artificially generated; however, the information used is according to ROKAF examples--the actual input format was devised by the authors to enable output of the Quality Control Outputs by Type of Inspection and Work Unit Code. Each element of the input will now be examined for validation purposes.

Type of Inspection. The data generation program produces five different types of quality control inspection. A greater number would be a closer approximation to reality but is considered unwarranted. The five types of inspections used are sufficient to test the capacity of the model to handle variety, without causing added complexity. The model will manipulate as much variety as exists in the real world so the use of only five types in the generation is not viewed as a limitation.

Inspection Number. The data generated also includes the capacity for sequential numbering of each inspection type for each julian date. This capability is not utilized by the model but may be necessary for later development of the model to output a proliferation of other reports. This characteristic is not required but adds authenticity.

Julian Date and Year. This element is used for initiation of the Quality Control Reports, as well as

enabling storage of data in data files for production of the Quality Control Output per Type of Inspection. No validation is required for this input, except to ensure that days were generated sequentially.

Aircraft Type. The four aircraft types are generated according to a uniform distribution; this data element is not required in the current output reports but may be a requisite under later modifications (e.g., output of discrepancies on QC inspections per aircraft type). Currently this field serves to lend authenticity to the data input.

Work Unit Code. Ten different work unit codes are generated according to a uniform distribution. Whilst it is recognized that this does not convey the whole gamut of codes available in the working environment, we believe that it does represent sufficient diversity for model verification.

Number of Discrepancies. The data generated will show the number of discrepancies as a two-digit field based on the output of a Poisson distribution with a lambda value specified by uniform distribution. There is no requirement to have realistic data in this field because the model merely uses this element to graph the discrepancies per inspection type, and to accumulate discrepancies per work

unit code--all that is required is that the numbers generated are sufficient to test the model. In this respect, this element is validated.

Few ROKAF quality control reports are available at this time to enable comprehensive verification of the quality control input. However, the data input should contain (as a minimum) the elements outlined above, each of which has been individually discussed and verified; the quality control input is therefore realistic.

Summary Delete Cards

The summary delete cards are generated according to the format shown in Figure 5. No Air Force manual describes the form of this card but a requirement exists under the model for information of the departure of aircraft from the depot level maintenance facility to enable output of the Production Summary Report. The delete card facilitates file maintenance functions, thereby eliminating the need for manual (intermittent) file closures. All that is required is that when the depot completes overhauling an aircraft, a delete card should be produced to record this event. No further validation appears necessary.

Summary

From the detailed discussion above the data input has been shown to be realistic, subject to the constraint

of limited variety in some instances. The next section will examine each of the reports output by the model.

Output Validation

This section will deal with each of the reports, examining them in detail and explaining how the information thereupon recorded is to be interpreted.

Quality Control Output per Type of Inspection

Reference to Appendix F will show a sample of the type of output generated by the model under this report. The objective of the output is to illustrate graphically the movement in the average number of discrepancies found for each type of inspection.

The output lists the type of inspection by name and month, followed by the total number of inspections of this type conducted at all of the work centers. The model then computes a discrepancy rate (mean average number of discrepancies per inspection type) based on the total number of discrepancies found on all inspections of that type for that month.

The graphical display is in the normal control chart format with an average ($\bar{c}$) computed from the past three months data for that inspection type. The output is in the form of one years data commencing at January for each year. This output is in the format required by

Figure 9 and hence meets the needs of the ROKAF. Limitations of this output are:

a. the vertical axis presents data to the nearest graphed point; i.e., it does not graph the exact position of the data, but only its general location with respect to the upper- and lower-control limits and $\bar{c}$. To obtain the exact rate requires examination of the tabular output above each chart; and

b. the normal chart prints a maximum of twelve months information--as of the commencement of each calendar year information from the previous year is not shown and hence it is not until December that a complete twelve months data is printed.

With these minor limitations in mind the output will enable ROKAF management to take early remedial action should there be an inordinate increase in the number of discrepancies discovered on QC inspections.

Quality Control Output per Work Unit Code

An example of the type of output given under this report is shown at Appendix G. The objective of this report is to list in tabular form the discrepancies found on quality control inspections for each work unit code.

The report shows all work unit codes for which QC reports have been input for the month--the model accesses

work unit code file for nomenclatures to increase the meaningfulness of the output. The work unit codes are sorted by the number of discrepancies found for that work unit code over all quality control inspections. The output also shows that percentage of total discrepancies which are attributable to that particular work unit code.

The output is in the format defined at Figure 11 and is therefore of the type required by ROKAF management. Therefore, the output is validated and no limitations are seen in the use of this report as it has the capability to sort and list all work unit codes used by the ROKAF. Therefore this report will be suitable for use in highlighting those work unit codes which are causing an inordinate strain on the maintenance function. This highlighting can then lead to increased managerial attention to that work unit code to discover the reasons for the increased burden of maintenance.

Number of Failures per Work Unit Code

An example of this report is shown as Appendix H. The objective here is to correct all of the data on direct labor accounting (except for mission aborts) to show the total number of failures that occur, listed by work unit code. The report ranks the work unit codes by the number of failures associated with each. Alongside each code is

printed the applicable nomenclature to increase readability. Finally, the total number of failures is shown.

The report is in the form shown as necessary by Figure 13 and hence is of the format required by ROKAF management. The report will output work unit codes for which failures occurred during the month and there is no limit on the number of such codes that can be output. There are no limitations on the use of this output which will be used to isolate those work unit codes which define the greatest number of equipment failures.

Number of Aborts per Work Unit Code

Reference to Appendix I will show an example of this report. The report shows all work unit codes for which mission aborts have been reported over the previous month. The work unit codes are ranked according to the frequency of occurrence of aborts; the WUC nomenclature is also included to enhance presentation, and then the actual number of aborts is recorded.

This report is in the format specified by Figure 15 and is hence in consonance with the requirements of the ROKAF. The objective is to delineate those work unit codes which define equipments causing mission aborts, and hence constrain equipment readiness. No limitations are envisaged on this output as it includes the ability to

output (and rank) as many work unit codes as are in use by the ROKAF.

Manhours Expended per Work Unit Base

Appendix J shows an example of the type of output given by this report. In effect, this report is issued in conjunction with the last two previously described--the model computes the hours expended on the maintenance function for each work unit code. This information is collated from the AF form 349s input as failures, aborts, and depot maintenance. The model sorts the work unit codes in descending order in accordance with the magnitude of the hours expended on maintenance functions associated with that work unit code. The report also prints the work unit code nomenclature to enhance readability.

The requisite format for this report is shown as Figure 17. The actual output is in accordance with this figure and hence the output fulfills the requirements of the ROKAF. The report will be used to isolate those equipment items that are causing the greatest burden to the total maintenance function. In this way management is able to concentrate its attention on those components which indicate excessive time for failure corrections; there is no limitation to the use of this report for the above-mentioned management function.

Failure Rate Summary

An example of this report is shown as Appendix K. The report is a compilation of the previous three reports, together with comparative data from the previous month. The report shows each work unit code listed in numerical order (for convenience), together with the applicable nomenclature. The report shows the number of failures (and ranking) for each WUC for the current and the past month; the same information is recorded for aborts. Likewise, the report shows the total number of direct labor manhours (and rankings) used over the month compared to those of the previous month.

Reference to Figure 19 will show the required format of this report; the actual format is in compliance with the dictates of this figure and hence will meet the requirements of the ROKAF. Besides acting as a compilation of the previous three reports, the fact that comparative statistics are available means that the report can be used to indicate movements in relative importance of particular work unit codes. There are no limitations to the use of this report (within the requirements stated).

Production Summary Report

Appendix L contains an example of this report. The objective of the report is to output the number of hours of maintenance utilized by each aircraft during the

performance of depot-level maintenance. Once an aircraft has left the depot a final manhour utilization entry is recorded; otherwise, each aircraft in the depot is shown together with the number of hours already consumed and a comparison against the number of hours authorized for that maintenance function. The report also shows whether there are authorized manhours still available, or whether the authorized limit has already been exceeded. This report is output quarterly.

From Figure 21 a copy of the required output format is available. A comparison with the output obtained will show that the actual output will satisfy the requirements of the ROKAF--the necessary information has been presented as required. This report will be used to determine which aircraft have exceeded their authorized manhour usage, those likely to exceed their authorized usage, leaving those which do not require managerial attention. This information can then be used for depot scheduling or to aid in managerial investigations of maintenance delays.

As the model currently operates, a standard number of hours for each aircraft type overhaul has been listed on a permanent file which is accessed each time the report is generated. A possible complication exists which has not been addressed by the model. The input method utilized from AF form 349 does not allow for the reporting of the type of overhaul that is being conducted. If there is a

variety of types of overhaul that are conducted on each aircraft type (a not unrealistic assumption) then this factor would need to be reported on the AF form 349 and the model would require some modification in the light of this circumstance. No other limitations exist.

Manpower Accounting Summary per Work Center

An example of the output generated as this report is shown as Appendix M. The objective of the report is to divide labor into three elements and provide a costing for each of these components for each work center. From the assigned manning permanent file for each work center the model accesses the total assigned manhours available for each work center each month. The model works on the basis that each man works 176 hours per month (22). The model totals direct labor and indirect labor, the difference between this sum and total hours available is referred to as "other." The costs are found through computing the total salary for each work center through interaction with the salary permanent file. Each component of labor is then allocated a cost in relation to the total cost in a direct relationship between that component and the total labor availability. The model also shows the authorized and assigned manning, and the percentage manning for each work center.

The format of the output required is shown as Figure 23; the actual output report includes all those elements required by the ROKAF in respect to manhour accounting. The report will be used to highlight those work centers which have an inordinate amount of nondirect labor in an endeavor to raise the element of direct labor which would result in an increase in productivity; the report will also show which work centers most need increased manpower assignments.

The major limitation to the model is that it does not have the capability of computing manhour costs when the assigned manning varies over the period of the month of the report. The same limitation is evident for the authorized manning but this varies so rarely that this does not act as a constraining factor. The model can be modified to require reporting of assigned manning whenever such a change occurs, and hence computing costs on a daily basis. This facility has not been incorporated in the model because of limited time availability.

Another minor limitation exists--the AF form 349 does not record the grade and seniority of the person/persons assigned the task covered by the AF form 349; hence, there is no means to defining the exact cost of each task. The method by which the model handles this constraint is to compute costings on the basis of averaged salaries for each work center. The resultant costings are therefore not

exact, but represent sufficiently accurate approximations to enable this report to be used as intended. To record the exact cost would necessitate the inclusion of grade/seniority data on the AF Form 349 and the resultant increase in decimal accuracy is not considered to be worth the extra data required for implementation.

Validation of the System

Information has been obtained from the ROKAF on the manning of all work centers used for F-4 maintenance (22). From this data five representative work centers were selected with manning as indicated:

a. K3110 (Repair Reclament Shop) - 24 men;

b. K3130 (Electrical Shop) - 21 men;

c. K3160 (Fuel System Shop) - 10 men;

d. K4110 (Flight Line Support Shop) - 43 men; and

e. K4230 (Electrical Navigation Shop) - 10 men.

(The details of authorized and assigned manpower for each of these shops is shown at Appendix P.) In the case of a depot no figures were presented--it was decided to assume that a depot would require approximately the same number of men as a flight line branch (for which figures are available). A representative figure was 71 men.

From the data supplied there are 1053 men assigned to the whole maintenance function; as the above work centers and depot total 179 men, we have made the not unrealistic

assumption that they would be responsible for 17 percent of all work generated each day. Now, we know that the maintenance system generates 600 cards per day (22); therefore, our work centers would be expected to generate approximately 17 percent of these cards, or 100 cards per day.

From the ROKAF data, salaries were available for each rank and increment thereto. This data was stored in permanent files for access in generation of the Manpower Accounting Summary. The assigned and authorized manning for each of the work centers was also stored in permanent files for interaction in the output of the Manpower Report.

The actual number of hours worked by each man is obviously subject to some variation each month but the information provided by the ROKAF indicates an average of 176 hours per man per month. This figure is based on a 44 hour week with 4 complete weeks per month, the remaining time being taken up in holidays. In fact, we question the exactness of this figure of 176 but take it at face value under the circumstances. Once the MDCS is put into practice by the ROKAF some deeper examination of the hours available each month may be warranted.

The ROKAF data indicated that there were approximately 138 QC inspections per month, or approximately 5 per day. The data generation program was therefore altered to ensure that approximately 96 percent of all items output were in the AF form 349 format, with the remainder being

in the quality control inspection format. This whole system of 105 cards per day was run for two years to obtain data for system validation.

System Production

With the algorithm producing approximately 105 cards per day for two complete years, the model was utilized to produce the required reports and the times taken for each segment were totalled. Because of the fact that data was generated through the computer, no definitive times were available for data input through the card punch medium. However, as some sample AF form 349s were available, the authors were able to punch up 50 cards in less than an average of 30 seconds each (an average of 24 seconds per card for 50 cards). It was therefore reasoned that a trained card punch operator would experience little difficulty in achieving a comparable rate of one card per 30 seconds over an extended period. (We believe this to be a much slower time that would actually be achieved but wish to consider a "worst case" situation.)

On the basis of card punch operations as outlined above, the time required to punch up 105 cards per day for one year is 320 hours, or 26 hours and 30 minutes per month. The actual computer manipulation for one years data was 18 minutes, plus 20 minutes for output printing (on a GE 115 PRT 100 printer). This means total system time is:

a. computer time per months: 3.2 minutes;

b. card punch time for month: 26 hours and 30 minutes; and therefore

c. total MDCS time: 26 hours and 33 minutes.

Data provided on the current system has been provided from the TCG at Hill AFB (21) and is shown as Figure 34.

	Report	Direct Manpower	Indirect Manpower	Total (Monthly)
a.	Production Summary	140	285	425
b.	Quality Control Outputs	140	265	405
c.	Manpower Accounting	160	360	520
d.	AF Form 349 Reports	375	589	964
				2314

Figure 34. Manual Output Times in Hours

Now, the data manipulated each month represents 17 percent of the total time for each of the following reports:

a. Production Summary-- 17% of 425 hours = 72.25

b. Manpower Accounting-- 17% of 520 hours = 88.40

c. AF Form 349 Reports-- 17% of 964 hours = 163.88

This totals to approximately 325 hours for manual output. In addition to this time, the model also utilizes all QC input each month and outputs all applicable reports. This would take 405 hours manually. Hence, the total manual

time required to duplicate the MDCS output would be (405 + 325 =) 730 hours.

The time computed for the MDCS was 26.5 hours which is less than 4 percent of the time required for the equivalent manual system of 730 hours. Based on the criterion for significance established in Chapter I, this figure is considered to show that the MDCS is significantly faster than the manual system, and examination of all reports output over the two-year period show that the model is operating as expected.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This thesis has examined the development and validation of an automated Maintenance Data Collection System for utilization by the Republic of Korea Air Force. The resultant system will serve two specific purposes:

1. This system will give a strong basis to the ROKAF management functions of the F-4 weapon system as they relate to maintenance and manhour accounting.

2. The MDCS will enable the ROKAF to make specific estimates of the needed logistical spare parts support required on an annual basis.

The final model developed is listed as Appendix Q.

Applicability

The previous chapter validated the model's use in the output of the following reports:

a. Quality Control report per Type of Inspection;

b. Quality Control report per Work Unit Code;

c. Number of Failures report per Work Unit Code;

d. Number of Aborts report per Work Unit Code;

e. Manhours Expended report per Work Unit Code;

f. Failure Rate Summary per Work Unit Code;

g. Production Summary Report; and

h. Manpower Accounting Summary report per Work Center.

Each of these reports is equally applicable for use by other countries which receive security support for the F-4 weapon system through the Technical Coordinating Group. The only requirement is that countries will need to collect and input their maintenance data in the same formats as presented in Chapter II of this thesis. Further, this will require the use of AF form 349 and appropriate AF Technical Orders and Manuals relating to maintenance functions. Additionally, Quality Control data will need to be recorded.

The model points out the fact that there does not appear to be a need to confine the use of this MDCS to F-4 weapon systems management, as the routines and algorithms are equally applicable to other weapon systems. As in all actual real world applications of any system, there will be a need to alter certain permanent files (e.g., salary, authorized and assigned manpower, etc.) to reflect local conditions, but this task simply requires the employment of a systems programmer to make the necessary system changes.

Limitations

Although the limitations to this model have been highlighted as they occurred in the validation outlined in Chapter III, one is particularly troublesome: changes in manning authorizations or assignments that occur during the month are not reflected in computations of manpower costs until the permanent manpower file has been updated. The limitation to the effective use of this system can be eliminated by use of a daily manning input and resultant computations, rather than the monthly computations which now exist; unfortunately, because of the pressure of limited time, the authors were not able to develop this capability themselves.

Further Development

As with all computer models developed, this MDCS leaves the possibility for further development limited only by the systems designer's imagination. However, there are some suggested areas for development.

1. Develop a daily manning input and a computation routine to enable a more refined manning cost figure to be produced.

2. Develop a routine to sort quality control data not only by type of inspection but also by Mission Design Series (MDS) of each specific weapon system.

3. Develop the capability to break down the depot maintenance activities by types of overhaul performed and the manhours devoted to each type of overhaul by weapon system.

From the data available to this model there is a plethora of other reports that could have been produced--it is in this field that we need to exercise restraint. The idea behind a report is to attenuate the variety of the real world situation to a meaningful scope that is comprehensible to the manager. To add to the proliferation of demands for an increased number of reports is often to increase the variety of the existent data, rather than to decrease that variety.

The reports generated currently by this MDCS meet the requirements of the ROKAF for advanced knowledge of possible equipment malfunctions to enable these components to be included in the following years Special Support Arrangement. Further, it creates a unique weapon system management system to reduce maintenance problems and inefficient manpower utilization. This thesis and development of the resultant MDCS have been confined to the satisfaction of this requirement. Once new requirements are definitized, and we express no doubt that such a requirement will be perceived, then the model will require further development. We leave it to the capable hands of future system analysts to fulfill these perceptions.

APPENDICES

APPENDIX A

GLOSSARY OF DEFINITIONS

Definitions

The following glossary of definitions will be used throughout the thesis and is presented here for the convenience of the reader.

Access--"the ability to retrieve data from a computerized storage media [7:2]."

Characteristic--"a specific capability or feature possessed by a retrieval system [7:2]."

Computer program--"A series of instructions or statements in a form acceptable to a computer [and] prepared in order to achieve a certain result [30:C-9]."

CREATE--the computer facility utilized at AFIT SLG.

Data base--"the collection of data stored within the computer system [7:2]."

Edit--"the capability to diagnose syntax errors in the retrieval system input parameters [7:2]."

File--"A collection of related records treated as a unit [30:F-2]."

Input--"data to be processed [30:I-4]."

Maintenance Data Collection System (MDCS)--a combination of computer programs aimed at manipulation of input maintenance data to enable an expansion of the data base to provide that information required by the MDRS.

Maintenance Data Retrieval System (MDRS)--a combination of computer programs to provide access to specific information in the data base, and then to output that information in a meaningful format.

On-line inquiry--"an immediate (normally a matter of seconds) response given to a question asked over a remote keyboard terminal, which is hooked up on-line to the central processor [7:8]."

Processing logic--"those predetermined series of steps in which data are internally manipulated within the computer system [7:2]."

Random sample--"a sample in which each element of the population has an equal and independent chance of being included [13:337]."

Record--"a collection of related items of data, treated as a unit [30:R-2]."

Retrieval system--computer programs or routines which have the capability to extract specified data from

computer storage, reformat or manipulate this data and output the data in the format specified by the requestor (25:1).

Sample--"any subset of elements from the universe or one of its populations [13:327]."

Syntax--rules for using a retrieval system (26:1-2).

APPENDIX B

SAMPLE COPY AF FORM 349

MAINTENANCE DATA COLLECTION RECORD

OMB NO. 21-R0227

1. JOB CONTROL NO.	2. WORK CENTER	3. I.D. NO./SERIAL NO.	4. MDS	5. EQ/CL	6. TIME	7. PRI	8. SORTIE NO.	9. LOCATION

10. ENG. TIME	11. ENGINE I.D.	12. INST ENG TIME	13. INST. ENG. I.D.	14.	15.	16	17. TIME SPC REQ	18. JOB STD.

19. FSC	20. PART NUMBER	21. SER. NO./OPER. TIME	22. TAG NO.	23. INST. ITEM PART NO.	24. SERIAL NUMBER	25. OPER. TIME

LINE	A TYPE MAINT	B COMP POS	C WORK UNIT CODE	D ACTION TAKEN	E WHEN DISC	F HOW MAL	G UNITS	H START HOUR	I STOP DAY	I STOP HOUR	J CREW SIZE	K CAT LAB	L CMD ACT ID	M SCH CODE	N EMPLOYEE NUMBER
1															
2															
3															
4															
5															

26. DISCREPANCY

27. CORRECTIVE ACTION

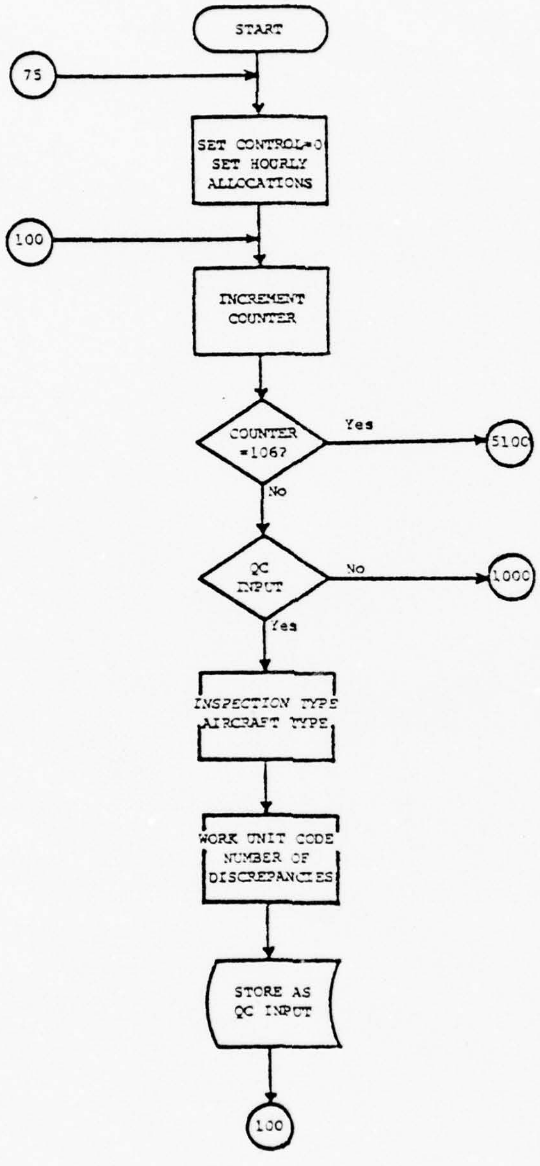
28. RECORDS ACTION

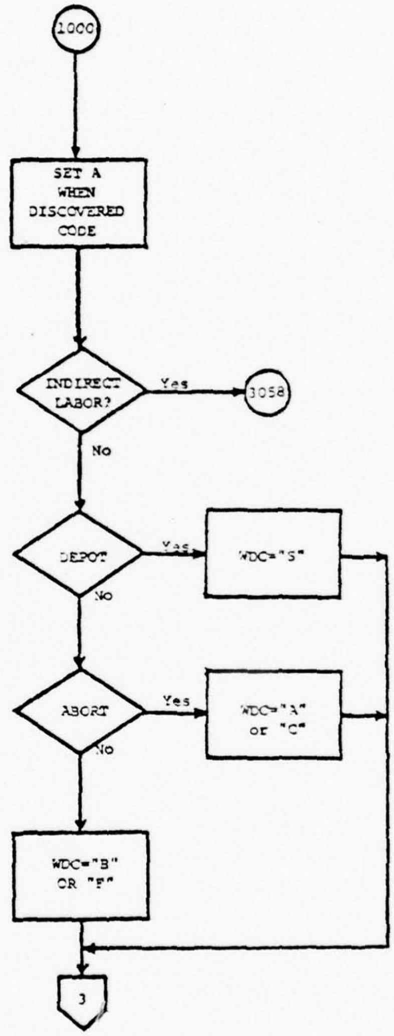
AFTO FORM DEC 74 349 TEST

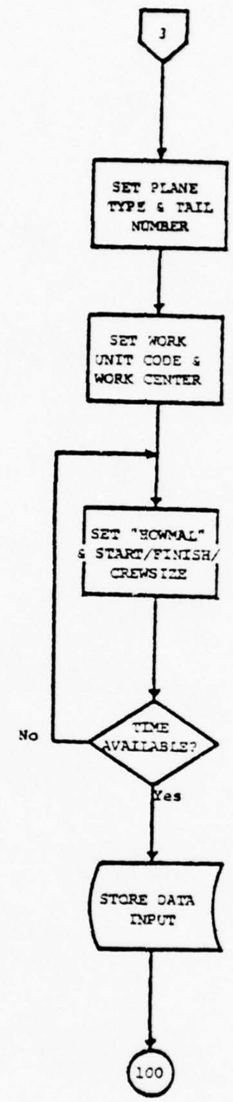
AFLC-WPAFB-JAN 75 400

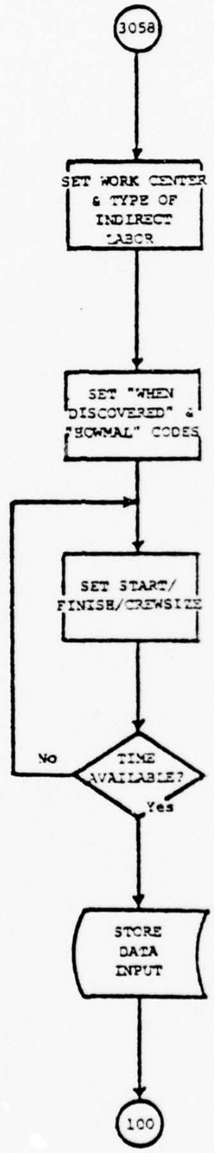
APPENDIX C

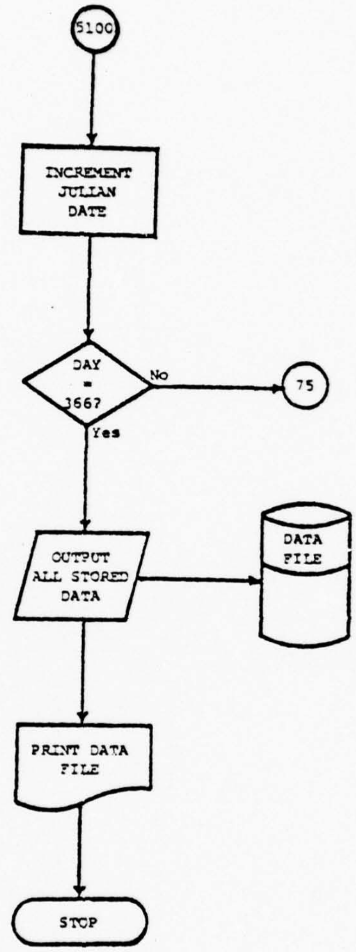
HIGH LEVEL FLOWCHART OF DATA GENERATION PROGRAM


START
75
SET CONTROL=0
SET HOURLY
ALLOCATIONS
100
INCREMENT
COUNTER
COUNTER
=106?
Yes
5100
No
QC
INPUT
No
1000
Yes
INSPECTION TYPE
AIRCRAFT TYPE
WORK UNIT CODE
NUMBER OF
DISCREPANCIES
STORE AS
QC INPUT
100


1000
SET A
WHEN
DISCOVERED
CODE
INDIRECT
LABOR?
Yes
3058
No
DEPOT
Yes
WDC="S"
No
ABORT
Yes
WDC="A"
or "C"
No
WDC="B"
OR "F"
3


J
SET PLANE TYPE & TAIL NUMBER
SET WORK UNIT CODE & WORK CENTER
SET "HOWMAL" & START/FINISH/ CREWSIZE
TIME AVAILABLE?
No
Yes
STORE DATA INPUT
100


3058
SET WORK CENTER & TYPE OF INDIRECT LABOR
SET "WHEN DISCOVERED" & "HOWMAL" CODES
SET START/ FINISH/CREWSIZE
TIME AVAILABLE?
No
Yes
STORE DATA INPUT
100


5100
INCREMENT JULIAN DATE
DAY = 366?
No
75
Yes
OUTPUT ALL STORED DATA
DATA FILE
PRINT DATA FILE
STOP

APPENDIX D

PROGRAM LISTING OF DATA GENERATION ALGORITHM

DATA GENERATION PROGRAMME (MDCS)

```
#RUN *=(ULIB)GRADLIB/ISS,R
      CALL CALLSS("REMO CLEARFILES#")
      ***************************************************************
      *                                                             *
      * THIS PROGRAMME GENERATES DATA FOR USE IN THE COMPUTER      *
      * MDCS DEVELOPED FOR THE ROKAF BY PAYNE & CALLAHAN AS        *
      * PART OF THE REQUIREMENTS OF THE MASTER OF SCIENCE IN       *
      * LOGISTICS. THE PROGRAMME GENERATES DATA IN THREE           *
      * BASIC FORMATS:                                              *
      *       1. A QUALITY CONTROL INPUT,                           *
      *       2. AF 349 INPUT FOR MAINTENANCE - MANHOUR             *
      *            ACCOUNTING, AND                                  *
      *       3. A SUMMARY DELETE INPUT.                            *
      *                                                             *
      ***************************************************************
      CALL CREATE(10,99999,0,ISTAT)
      CHARACTER TYPINS*5,ACRAFT*7,WKUCOD*5,NONTROL*4,
      PLANE*6,INO*2,PLATH*6,ENGNO*6,WNDISC*1,HOWMAL*3,
      WKCEN*5,PLAN*6,PLANE1*6,PLANE2*6,PLANE3*6,
      PLANE4*6,PLANE5*6,PLANE6*6,TN*2,TAIL1*2,TAIL3*2,
      TAIL4*2,TAIL5*2,TAIL6*2,K3110*5,K3130*5,
      K3160*5,K4110*5,K4230*5,DEL*6,TAIL2*2
      INTEGER GYR/77/
      JUL = 001
      KNI=00
      I=0
      GO TO 1080
  74  GYR    = 77
  75  KNT    = 00
      APLNO = 90
      QPONO = 00
      QDINO = 00
      QUINO = 99
      AGLNO = 90
      KOUNT = 0
      KDLPOT = 0000
      KONTROL= 0000
      KONTR1 = 0000
      KONTR2 = 0000
      KONTR3 = 0000
      KONTR4 = 0003
      KONTR5 = 0006
      IHRS1=4224
      IHRS2=3696
      IHRS3=1760
```

```
      IHRS4=7560
      IHRS5=1760
      IHRS0=12196
  100 KNT=KNT+1
      IF(KNT.EQ.106) GO TO 5100
      X=RND(-1.0)
      IF(X.GT..04) GO TO 1000
      X=RND(-1.0)
      IF(X.LT..2) GO TO 222
      IF(X.GT..2.AND.X.LE..4) GO TO 333
      IF(X.GT..4.AND.X.LE..6) GO TO 444
      IF(X.GT..6.AND.X.LE..8) GO TO 555
      IF(X.GT..8) GO TO 565
  222 TYPINS = "  OPE"
      OPENO = OPENO + 1
      INSNO = OPENO
      GO TO 666
  333 TYPINS = "  OPO"
      OPONO = OPONO + 1
      INSNO = OPONO
      GO TO 666
  444 TYPINS = "  ODI"
      ODINO = ODINO + 1
      INSNO = ODINO
      GO TO 666
  555 TYPINS = "  QUI"
      QUINO = QUINO + 1
      INSNO = QUINO
      GO TO 666
  565 TYPINS = " 5AGE"
      AGENO = AGENO + 1
      INSNO = AGENO
  666 X=RND(-1.0)
      IF(X.LT..25) ACRAFT = "  F004C"
      IF(X.GT..25.AND.X.LE..5) ACRAFT = "  F004D"
      IF(X.GT..5.AND.X.LE..75) ACRAFT = "  F004E"
      IF(X.GT..75) ACRAFT = " RF004C"
  875 X=RND(-1.0)
      IF(X.LT..1) WKUCOD = "11111"
      IF(X.GT..1.AND.X.LE..2) WKUCOD = "12345"
      IF(X.GT..2.AND.X.LE..3) WKUCOD = "22222"
      IF(X.GT..3.AND.X.LE..4) WKUCOD = "33333"
      IF(X.GT..4.AND.X.LE..5) WKUCOD = "44444"
      IF(X.GT..5.AND.X.LE..6) WKUCOD = "55555"
      IF(X.GT..6.AND.X.LE..7) WKUCOD = "66666"
      IF(X.GT..7.AND.X.LE..8) WKUCOD = "77777"
      IF(X.GT..8.AND.X.LE..9) WKUCOD = "88888"
```

```
      IF(X.GT..9) WKUCOD = "99999"
  919 X=RND(-1.0)
      IF(X.LT..2) AL= 2.
      IF(X.GT..2.AND.X.LE..4) AL = 3.
      IF(X.GT..4.AND.X.LE..6) AL = 4.
      IF(X.GT..6.AND.X.LE..8) AL = 5.
      IF(X.GT..8) AL = 6.
      X=POISSON(AL,1.)
      NDISC = X
      JUL = JUL + 1000
      WRITE(10,945)TYPINS,INSNO,JUL,NYR,ACRAFT,WKUCOD,NDISC
      TYPINS = " "
      ACRAFT = " "
      WKUCOD = " "
  945 FORMAT(A5,1X,I2,1X,I3,I2,1X,A7,1X,A5,1X,I2)
      JUL = JUL - 1000
      GO TO 109
 1000 X=RND(-1.0)
      IF(X.LT..2) GO TO 3051
      IF(X.GT..2.AND.X.LT..45) GO TO 1003
      IF(X.GT..45.AND.X.LE..55) WNDISC = "A"
      IF(X.GT..55.AND.X.LE..6) WNDISC = "B"
      IF(X.GT..6.AND.X.LT..65) WNDISC = "C"
      IF(X.GT..65) WNDISC = "E"
      GO TO 1050
 1003 KDEPOT=KDEPOT + 1
      KONTROL=KDEPOT
      WKCEN = "DEPOT"
      WNDISC = "S"
 1050 IF(KNT.NE.1) GO TO 2024
      IF(JUL.EQ.001) GO TO 1000
      IF(KNT.EQ.1) DEL="DELETE"
      WRITE(10,1051)PLANE6,TAIL6,DEL,PLANE6
 1051 FORMAT(12X,A6,A2,1X,A6,1X,A6)
 1080 KOUNT=0
 1081 KOUNT=KOUNT+1
      X=RND(-1.0)
      IF(X.LT..25) PLAN = " F004C"
      IF(X.GT..25.AND.X.LE..5) PLAN = " F004D"
      IF(X.GT..5.AND.X.LE..75) PLAN = " F004E"
      IF(X.GT..75) PLAN = "RF004C"
 1091 X=RND(-1.0)
      IF(X.LE..05) TN = "01"
      IF(X.GT..05.AND.X.LE..10) TN = "02"
      IF(X.GT..10.AND.X.LE..15) TN = "03"
      IF(X.GT..15.AND.X.LE..20) TN = "04"
      IF(X.GT..20.AND.X.LE..25) TN = "05"
```

```
      IF(X.GT..25.AND.X.LE..30) IN = "06"
      IF(X.GT..30.AND.X.LE..35) IN = "07"
      IF(X.GT..35.AND.X.LE..40) IN = "08"
      IF(X.GT..40.AND.X.LE..45) IN = "09"
      IF(X.GT..45.AND.X.LE..50) IN = "10"
      IF(X.GT..50.AND.X.LE..55) IN = "11"
      IF(X.GT..55.AND.X.LE..60) IN = "12"
      IF(X.GT..60.AND.X.LE..65) IN = "13"
      IF(X.GT..65.AND.X.LE..70) IN = "14"
      IF(X.GT..70.AND.X.LE..75) IN = "15"
      IF(X.GT..75.AND.X.LE..80) IN = "16"
      IF(X.GT..80.AND.X.LE..85) IN = "17"
      IF(X.GT..85.AND.X.LE..90) IN = "18"
      IF(X.GT..90.AND.X.LE..95) IN = "19"
      IF(X.GT..95) IN = "20"
      IF(KOUNT.EQ.1) GO TO 2015
      IF(KOUNT.EQ.2) GO TO 2016
      IF(KOUNT.EQ.3) GO TO 2017
      IF(KOUNT.EQ.4) GO TO 2018
      IF(KOUNT.EQ.5) GO TO 2020
      IF(KOUNT.EQ.6) GO TO 2022
 2015 PLANE1=PLAN
      TAIL1=IN
      GO TO 1091
 2016 PLANE2=PLAN
      TAIL2=IN
      IF(TAIL2.NE.TAIL1) GO TO 1081
      IF(PLANE1.NE.PLANE2) GO TO 1081
      GO TO 1091
 2017 PLANE3=PLAN
      TAIL3=IN
      IF(TAIL3.NE.TAIL2.OR.TAIL3.NE.TAIL1) GO TO 1081
      IF(PLANE3.NE.PLANE2.OR.PLANE3.NE.PLANE1) GO TO 1081
      GO TO 1091
 2018 PLANE4=PLAN
      TAIL4=IN
      IF(TAIL4.EQ.TAIL3.OR.TAIL4.EQ.TAIL2) GO TO 2019
      IF(TAIL4.EQ.TAIL1) GO TO 2019
      GO TO 1031
 2019 IF(PLANE4.EQ.PLANE3.OR.PLANE4.EQ.PLANE2) GO TO 1091
      IF(PLANE4.EQ.PLANE1) GO TO 1091
      GO TO 1091
 2020 PLANE5=PLAN
      TAIL5=IN
      IF(TAIL5.EQ.TAIL4.OR.TAIL5.EQ.TAIL3) GO TO 2021
      IF(TAIL5.EQ.TAIL2.OR.TAIL5.EQ.TAIL1) GO TO 2021
      GO TO 1081
```

```
4230 2021 IF(PLANE5.EQ.PLANE4.OR.PLANE5.EQ.PLANE3) GO TO 1091
4240      IF(PLANE5.EQ.PLANE2.OR.PLANE5.EQ.PLANE1) GO TO 1091
4250      GO TO 1031
4260 2022 PLANE6=PLAN
4270      TAIL6=IN
4280      IF(TAIL6.EQ.TAIL5.OR.TAIL6.EQ.TAIL4) GO TO 2023
4290      IF(TAIL6.EQ.TAIL3.OR.TAIL6.EQ.TAIL2) GO TO 2023
4300      IF(TAIL6.EQ.TAIL1) GO TO 2023
4310      GO TO 2024
4320 2023 IF(PLANE6.EQ.PLANE5.OR.PLANE6.EQ.PLANE4) GO TO 1091
4330      IF(PLANE6.EQ.PLANE3.OR.PLANE6.EQ.PLANE2) GO TO 1091
4340      IF(PLANE6.EQ.PLANE1) GO TO 1091
4350 2024 IF(JUL.EQ.001.AND.KNT.EQ.00) GO TO 74
4360      X=RND(-1.0)
4370      IF(X.LT..1) WKUCOD = "11111"
4390      IF(X.GT..1.AND.X.LE..2) WKUCOD = "12345"
4410      IF(X.GT..2.AND.X.LE..3) WKUCOD = "22222"
4420      IF(X.GT..3.AND.X.LE..4) WKUCOD = "33333"
4430      IF(X.GT..4.AND.X.LE..5) GO TO 2030
4440      IF(X.GT..5.AND.X.LE..6) WKUCOD = "55555"
4450      IF(X.GT..6.AND.X.LE..7) WKUCOD = "66666"
4460      IF(X.GT..7.AND.X.LE..8) WKUCOD = "77777"
4470      IF(X.GT..8.AND.X.LE..9) WKUCOD = "88888"
4480      IF(X.GT..9) WKUCOD = "99999"
4482      ENGNO = "      "
4485      GO TO 2050
4486 2030 WKUCOD = "44444"
4487      ENGNO = "ABC123"
4700 2050 IF(WNDISC.NE."S") GO TO 2051
4710      PLANE=PLANE6
4720      INO=TAIL6
4730      GO TO 2064
4740 2051 X=RND(-1.0)
4750      IF(X.LT..2) GO TO 2052
4760      IF(X.GT..2.AND.X.LE..40) GO TO 2053
4770      IF(X.GT..40.AND.X.LE..52) GO TO 2054
4780      IF(X.GT..52.AND.X.LE..80) GO TO 2055
4790      IF(X.GT..80) GO TO 2056
4800 2052 WKCEN="K3110"
4810      KONTR1=KONTR1 + 1
4820      KONTROL=KONTR1
4830      PLANE=PLANE1
4840      INO=TAIL1
4850      GO TO 2064
4860 2053 WKCEN="K3130"
4870      KONTR2=KONTR2 + 1
4880      KONTROL=KONTR2
```

```
      PLANE=PLANE2
      IND=TAIL2
      GO TO 2064
 2054 UKCEN="K3160"
      KONTR3=KONTR3 + 1
      KONTROL=KONTR3
      IND=TAIL3
      GO TO 2064
 2055 UKCEN="K3110"
      KONTR4=KONTR4 + 1
      KONTROL = KONTR4
      PLANE=PLANE4
      IND=TAIL4
      GO TO 2064
 2056 UKCEN="K4230"
      KONTR5=KONTR5 + 1
      KONTROL=KONTR5
      PLANE=PLANE5
      IND=TAIL5
 2064 X=RND(-1.0)
      IF(X.LT..1) NORMAL = "100"
      IF(X.GT..1.AND.X.LE..2) NORMAL = "200"
      IF(X.GT..2.AND.X.LE..3) NORMAL = "300"
      IF(X.GT..3.AND.X.LE..4) NORMAL = "400"
      IF(X.GT..4.AND.X.LE..5) NORMAL = "500"
      IF(X.GT..5.AND.X.LE..6) NORMAL = "600"
      IF(X.GT..6.AND.X.LE..7) NORMAL = "700"
      IF(X.GT..7.AND.X.LE..8) NORMAL = "800"
      IF(X.GT..8.AND.X.LE..9) NORMAL = "900"
      IF(X.GT..9) NORMAL = "950"
 2077 ST=RND(-1.0)
      IF(ST.LE..02) KSTART=04
      IF(ST.GT..02.AND.ST.LE..05) KSTART=05
      IF(ST.GT..05.AND.ST.LE..10) KSTART=06
      IF(ST.GT..10.AND.ST.LE..20) KSTART=07
      IF(ST.GT..20.AND.ST.LE..60) KSTART=08
      IF(ST.GT..60.AND.ST.LE..70) KSTART=09
      IF(ST.GT..70.AND.ST.LE..75) KSTART=10
      IF(ST.GT..75.AND.ST.LE..80) KSTART=11
      IF(ST.GT..80.AND.ST.LE..85) KSTART=12
      IF(ST.GT..85.AND.ST.LE..89) KSTART=13
      IF(ST.GT..89.AND.ST.LE..92) KSTART=14
      IF(ST.GT..92.AND.ST.LE..95) KSTART=15
      IF(ST.GT..95.AND.ST.LE..98) KSTART=16
      IF(ST.GT..98) KSTART=17
 2094 FT=RND(-1.0)
      IF(FT.LE..01) KFIN = 01
```

```
      IF(FI.GT..01.AND.FI.LE..03) KFIN = 02
      IF(FI.GT..03.AND.FI.LE..06) KFIN = 03
      IF(FI.GT..06.AND.FI.LE..08) KFIN = 04
      IF(FI.GT..08.AND.FI.LE..11) KFIN = 11
      IF(FI.GT..11.AND.FI.LE..15) KFIN = 12
      IF(FI.GT..15.AND.FI.LE..20) KFIN = 13
      IF(FI.GT..20.AND.FI.LE..25) KFIN = 14
      IF(FI.GT..25.AND.FI.LE..30) KFIN = 15
      IF(FI.GT..30.AND.FI.LE..50) KFIN = 16
      IF(FI.GT..50.AND.FI.LE..70) KFIN = 17
      IF(FI.GT..70.AND.FI.LE..80) KFIN = 18
      IF(FI.GT..80.AND.FI.LE..85) KFIN = 19
      IF(FI.GT..85.AND.FI.LE..90) KFIN = 20
      IF(FI.GT..90.AND.FI.LE..94) KFIN = 21
      IF(FI.GT..94.AND.FI.LE..96) KFIN = 22
      IF(FI.GT..96.AND.FI.LE..98) KFIN = 23
      IF(FI.GT..98) KFIN = 00
 3014 ICOM=KSTART-KFIN
      IF(ICOM.EQ.0) GO TO 2094
      IF(ICOM.GT.12) GO TO 2077
      IF(ICOM.LT.-12) GO TO 2077
      IF(ICOM.GT.0) GO TO 3016
      IF(ICOM.LT.0) GO TO 3015
 3015 ISHIFT=000
      GO TO 3017
 3016 NUM=(KFIN+24) - KSTART
      IF(NUM.GT.12) GO TO 2094
      ISHIFT=100
      KFIN=KFIN + 24
 3017 X=RND(-1.0)
      IF(X.LE..40) KREWSZ = 1
      IF(X.GT..40.AND.X.LE..70) KREWSZ = 2
      IF(X.GT..70.AND.X.LE..85) KREWSZ = 3
      IF(X.GT..85.AND.X.LE..95) KREWSZ = 4
      IF(X.GT..95.AND.X.LE..98) KREWSZ = 5
      IF(X.GT..98.AND.X.LE..99) KREWSZ = 6
      IF(X.GT..99) KREWSZ = 7
 3025 KHRWK=KFIN - KSTART
      KTHRWK=KHRWK * KREWSZ
      IF(WKCLN.NE."K3110") GO TO 3027
      IHRS1=IHRS1-KTHRWK
      IF(IHRS1.LE.0) GO TO 3026
      GO TO 3039
 3026 KONTR1=KONTR1-1
      IHRS1=IHRS1+KTHRWK
      GO TO 199
 3027 IF(WKCLN.NE."K3130") GO TO 3029
```

```
      IHRS2=IHRS2-KTHRWK
      IF(IHRS2.LE.0) GO TO 3028
      GO TO 3039
3028  KONTR2=KONTR2-1
      IHRS2=IHRS2+KTHRWK
      GO TO 100
3029  IF(WKCEN.NE."K3160") GO TO 3031
      IHRS3=IHRS3-KTHRWK
      IF(IHRS3.LE.0) GO TO 3030
      GO TO 3039
3030  KONTR3=KONTR3-1
      IHRS3=IHRS3+KTHRWK
      GO TO 100
3031  IF(WKCEN.NE."K4110") GO TO 3033
      IHRS4=IHRS4-KTHRWK
      IF(IHRS4.LE.0) GO TO 3032
      GO TO 3039
3032  KONTR4=KONTR4-1
      IHRS4=IHRS4+KTHRWK
      GO TO 100
3033  IF(WKCEN.NE."K4230") GO TO 3037
      IHRS5=IHRS5-KTHRWK
      IF(IHRS5.LE.0) GO TO 3034
      GO TO 3039
3034  KONTR5=KONTR5-1
      IHRS5=IHRS5+KTHRWK
      GO TO 100
3037  IHRSD=IHRSD-KTHRWK
      IF(IHRSD.LE.0) GO TO 3038
      GO TO 3039
3038  KDEPOT=KDEPOT-1
      IHRSD=IHRSD+KTHRWK
      GO TO 100
3039  IF(IHO.EQ."LF") GO TO 3040
      PLAIN = PLANE
      GO TO 3041
3040  PLAIN="        "
3041  IF(KFIN.LT.25) GO TO 5000
      KFIN = KFIN - 24
      GO TO 5000
3051  X=RND(-1.0)
      IF(X.LE..13) WKCEN = "K3110"
      IF(X.GT..13.AND.X.LE..26) WKCEN = "K3130"
      IF(X.GT..26.AND.X.LE..33) WKCEN = "K3160"
      IF(X.GT..33.AND.X.LE..52) WKCEN = "K4110"
      IF(X.GT..52.AND.X.LE..59) WKCEN = "K4230"
      IF(X.GT..59) WKCEN = "DEPOT"
```

```
 3058 X=RND(-1.0)
      IF(X.LT..2) WKUCOD = "ALT00"
      IF(X.GT..2.AND.X.LE..4) WKUCOD = "CMP00"
      IF(X.GT..4.AND.X.LE..6) WKUCOD = "DTL00"
      IF(X.GT..6.AND.X.LE..8) WKUCOD = "LVLOV"
      IF(X.GT..8) WKUCOD = "IR000"
 3064 NONTROL = "    "
      DECODE(NONTROL,4500)KONTROL
 4500 FORMAT(I4)
      PLANE = "    IND"
      IND = "LT"
      ENGDD = "        "
      UNDISC = " "
      NORMAL = "    "
      KSTART=0!
      IS1=0
      IS2=0
      KFIN=17
      KF1=0
      KF2=0
      GO TO 3017
 5000 X=RND(-1.0)
      IF(X.LE..17) IS1=0
      IF(X.GT..17.AND.X.LE..34) IS1=1
      IF(X.GT..34.AND.X.LE..50) IS1=2
      IF(X.GT..50.AND.X.LE..67) IS1=3
      IF(X.GT..67.AND.X.LE..84) IS1=4
      IF(X.GT..84) IS1=5
      X=RND(-1.0)
      IF(X.LE..1) IS2=0
      IF(X.GT..1.AND.X.LE..2) IS2=1
      IF(X.GT..2.AND.X.LE..3) IS2=2
      IF(X.GT..3.AND.X.LE..4) IS2=3
      IF(X.GT..4.AND.X.LE..5) IS2=4
      IF(X.GT..5.AND.X.LE..6) IS2=5
      IF(X.GT..6.AND.X.LE..7) IS2=6
      IF(X.GT..7.AND.X.LE..8) IS2=7
      IF(X.GT..8.AND.X.LE..9) IS2=8
      IF(X.GT..9) IS2=9
      X=RND(-1.0)
      IF(X.LE..17) KF1=0
      IF(X.GT..17.AND.X.LE..34) KF1=1
      IF(X.GT..34.AND.X.LE..50) KF1=2
      IF(X.GT..50.AND.X.LE..67) KF1=3
      IF(X.GT..67.AND.X.LE..84) KF1=4
      IF(X.GT..84) KF1=5
      X=RND(-1.0)
```

```
      IF(X.LT..1) KF2=0
      IF(X.GT..1.AND.X.LE..2) KF2=1
      IF(X.GT..2.AND.X.LE..3) KF2=2
      IF(X.GT..3.AND.X.LE..4) KF2=3
      IF(X.GT..4.AND.X.LE..5) KF2=4
      IF(X.GT..5.AND.X.LE..6) KF2=5
      IF(X.GT..6.AND.X.LE..7) KF2=6
      IF(X.GT..7.AND.X.LE..8) KF2=7
      IF(X.GT..8.AND.X.LE..9) KF2=8
      IF(X.GT..9) KF2=9
 5020 JUL = JUL + 1000
      KONTROL = KONTROL + 10000
      KSTART = KSTART + 100
      IS1 = IS1 + 10
      ISHIFT = ISHIFT + 1000
      KFIN = KFIN + 100
      KF1 = KF1 + 10
      WRITE(10,5080)JUL,KONTROL,WKGEN,PLANE,INO,PLAIN,ENGNO,
     &WKUCOD,WNDISC,NORMAL,KSTART,IS1,IS2,ISHIFT,KFIN,
     &KF1,KF2,KRENS7
      WKGEN = " "
      PLANE = " "
      INO = " "
      PLAIN = " "
      ENGNO = " "
      WKUCOD = " "
      WNDISC = " "
      NORMAL = " "
 5080 FORMAT(I3,I4,A5,A6,A2,8X,A6,8X,A6,4X,A5,1X,A1,A3,2X,
     &I2,I1,I1,I3,I2,I1,I1,I1)
      JUL = JUL - 1000
      KONTROL = KONTROL - 10000
      KSTART = KSTART - 100
      IS1 = IS1 - 10
      ISHIFT = ISHIFT - 1000
      KFIN = KFIN - 100
      KF1 = KF1 - 10
      GO TO 199
 5100 JUL = JUL + 1
      IF(JUL.EQ.897) GO TO 5150
      GO TO 75
 5150 REWIND 10
      STOP
      END
```

APPENDIX E

EXAMPLE OF DATA GENERATION ALGORITHM OUTPUT

```
0010000K3130    INDLB                                          ALTOO        085200017134
0010001DEPOT  F004E13              F004E                       33333  S300  101300018481
0010001K3130RF004C03              RF004C                       22222  F500  094200016041
0010001K4110  F004E16              F004E                       99999  B800  082900017171
0010002DEPOT  F004E13              F004E                       12345  S400  145800016191
0010001K3110  F004D05              F004D                       88888  F500  083200016175
0010000K3160    INDLB                                          CMPOO        083600017151
0010001K4230  F004C19              F004C                       11111  F500  080900016017
0010000K4230    INDLB                                          DTLOO        083600017493
0010003DEPOT  F004E13              F004E                       33333  S600  115000016416
0010002K4110  F004E16              F004E                       22222  F500  082600014171
              F004E13  DELETE      F004E
0020001DEPOTRF004C13              RF004C                       88888  S500  080000017343
   BPE  1 00277    F004C 33333  4
0020001K3160RF004C01              RF004C                       88888  F200  110600017533
0020001K4110  F004E11              F004E           ABC123      44444  F700  085400018444
0020002DEPOTRF004C13              RF004C                       88888  S950  091500017002
0020003DEPOTRF004C13              RF004C                       88888  S600  110400015362
0020001K3110  F004E17              F004E                       88888  A400  164100022302
0020000K4110    INDLB                                          LVEOV        080400017464
0020002K4110  F004E11              F004E                       77777  A900  084300014422
0020001K3130RF004C06              RF004C                       12345  F100  125000020201
0020002K3130RF004C06              RF004C                       99999  F600  080000017542
             RF004C13  DELETE     RF004C
0030001K3110RF004C05              RF004C                       99999  F200  083100014171
0030000K3110    INDLB                                          LVEOV        081000017534
0030000K3110    INDLB                                          CMPOO        085000017573
0030000K3130    INDLB                                          DTLOO        082400017582
   QDI  1 00377   RF004C 77777  2
0030000K4230    INDLB                                          DTLOO        084600017561
0030001K3160  F004C07              F004C                       77777  F900  160300021483
0030002K3110RF004C05              RF004C                       55555  F600  092300014234
0030000DEPOT    INDLB                                          ALTOO        084900017493
0030001K4230  F004D11              F004D                       99999  F200  083300016424
0030001K3130  F004E05              F004E                       99999  F500  071800015264
   BPO  1 03377    F004C 44444 10
   QDI  1 03477    F004C 55555  3
0340001K4110  F004D17              F004D                       12345  F700  050200016111
0340001K4230  F004D13              F004D                       77777  B100  080200019275
   BPE  1 03477    F004C 99999  3
0340001DEPOTRF004C12              RF004C                       55555  S100  164100019013
0340001K3160RF004C15              RF004C                       66666  F700  125800018381
   BPO  1 03477   RF004C 33333  6
0340002DEPOTRF004C12              RF004C                       55555  S900  093400018391
0340003DEPOTRF004C12              RF004C                       55555  S200  081500014593
0340004DEPOTRF004C12              RF004C                       12345  S900  102400019075
0340001K3130  F004D15              F004D                       22222  B200  093700018453
   QDI  1 03577    F004D 88888  6
0350000K4110    INDLB                                          DTLOO        085000017582
0350001K4230  F004D13              F004D                       22222  F800  083600016023
0350001DEPOTRF004C12              RF004C                       55555  S100  090200016302
0350001K4110  F004D17              F004D                       99999  F800  050200016524
0350002DEPOTRF004C12              RF004C                       55555  S700  081100016264
0350003DEPOTRF004C12              RF004C                       88888  S500  121900014073
0350000DEPOT    INDLB                                          TRNOO        082900017011
0350004DEPOTRF004C12              RF004C                       66666  S700  134100017491
```

```
0350004DEPOTRF004C12          RF004C                    66666 S700  134100017491
0350001K3110 F004D06           F004D                    99999 F100  091900018254
0350002K4230 F004D13           F004D                    33333 F100  141500016583
            RF004C12 DELETE RF004C
0360001DEPOT F004D06           F004D                    99999 S950  082200016122
0360001K4230 F004D04           F004D                    55555 B100  120400015053
0360000DEPOT   INDLB                                    DTLOO       084800017221
0360001K3110RF004C17          RF004C                    66666 F200  072400012403
0360001K3130RF004C11          RF004C          ABC123    44444 F700  170900020092
  QUI  1 03677   F004D 12345  7
0360000DEPOT   INDLB                                    ALTOO       083000017203
0360002K3110RF004C17          RF004C                    77777 F900  175100020071
0360002K3130RF004C11          RF004C                    22222 F950  070500017401
  QDI  1 03677   F004C 33333  7
0360002DEPOT F004D06           F004D                    11111 S100  085000017451
            RF004C11 DELETE RF004C
  QDI  1 06277   F004E 99999  6
 SAGE  1 06277   F004E 88888  1
             F004D12 DELETE  F004D
0630001K3160   IND16             IND                    66666 F200  080200019564
0630001DEPOT F004D14           F004D                    88888 S900  104000016513
0630002DEPOT F004D14           F004D                    11111 S950  081200019344
0630001K3130 F004D12           F004D                    55555 A800  150700016354
0630003DEPOT F004D14           F004D          ABC123    44444 S400  101100016326
0630004DEPOT F004D14           F004D                    66666 S800  082700017227
0630000DEPOT   INDLB                                    LVEOV       085800017482
0630001K4230RF004C13          RF004C                    12345 C200  061800017302
 SAGE  1 06377   F004D 33333 10
0630001K4110RF004C07          RF004C                    99999 F300  061400017577
  BPO  1 06377   F004E 77777  2
             F004D14 DELETE  F004D
0640001DEPOT F004C03           F004C                    77777 S600  131600020304
0640002DEPOT F004C03           F004C                    11111 S200  085900017161
0640003DEPOT F004C03           F004C                    77777 S600  073600017486
0640001K3160 F004C05           F004C                    99999 F100  092100013451
0640000K4110   INDLB                                    TRNOO       084100017503
0640000K4230   INDLB                                    DTLOO       083300017521
0640001K4110RF004C20          RF004C                    66666 C600  062700016003
0640000K4110   INDLB                                    DTLOO       083300017121
 SAGE  1 06477  RF004C 22222  2
0640001K3110 F004C05           F004C                    33333 F200  144700017527
  BPO  1 06477   F004C 55555  2
             F004C03 DELETE  F004C
0650001K3160 F004C09           F004C                    11111 F300  085500015413
0650000DEPOT   INDLB                                    CMPOO       084600017233
0650001DEPOT F004D02           F004D          ABC123    44444 S600  084300014152
  BPE  1 06577  RF004C 66666  3
0650002K3160 F004D09           F004D                    22222 F800  141000020492
0650000K3130   INDLB                                    DTLOO       080400017205
 SAGE  1 06577   F004D 11111  9
0650000DEPOT   INDLB                                    CMPOO       080000017442
0650001K4230 F004D06           F004D                    66666 F600  085900015121
0650001K3130RF004C04          RF004C                    22222 A100  084000016242
0650002K4230 F004D06           F004D                    33333 F800  091800014301
```

```
0650002K4230 F004D06            F004D              33333 F800  091800014301
             F004C07 DELETE   F004C
 SAGE   1 09377    F004C 55555  4
             F004D15 DELETE   F004D
0940001K3160 F004E19            F004E              66666 A200  080300016452
0940001K4110 F004D15            F004D              88888 F200  125800017081
0940000K3130    INDLB                              DTLOO       084000017551
0940001K4230 F004C05            F004C              66666 F200  074500016222
0940002K4110 F004D15            F004D              11111 F700  085000018481
  QDI   1 09477    F004C 99999  1
0940001DEPOT F004C08            F004C              88888 S100  084300017055
0940002DEPOT F004C08            F004C              77777 S200  080500017371
0940003DEPOT F004C08            F004C              22222 S950  071200017021
 SAGE   1 09477    F004E 33333  5
0940004DEPOT F004C08            F004C              77777 S400  083000017222
             F004C08 DELETE   F004C
0950001DEPOT F004D10            F004D              11111 S600  134100017472
  QUI   1 09577    F004C 55555  1
0950000K3130    INDLB                              ALTOO       081300017203
  QUI   2 09577    F004E 55555  6
  BPO   1 09577   RF004C 77777  3
  BPE   1 09577    F004D 12345  2
0950000K3110    INDLB                              DTLOO       083800017313
0950001K3130 F004D17            F004D              12345 C400  084600019082
0950001K3160 F004D02            F004D              12345 F400  130300018052
0950002DEPOT F004D10            F004D              77777 S400  080800017444
0950001K4110 F004D16            F004D              22222 F900  150200019522
  QDI   1 09677    F004E 99999  2
  BPE   1 09677    F004C 88888  4
0960001K4110 F004D16            F004D     ABC123   44444 F600  141800019215
  QUI   1 09677    F004E 55555  5
0960002K4110 F004D16            F004D              12345 F900  140700021011
0960001K3130 F004D17            F004D              22222 F100  082700016137
0960000K4230    INDLB                              TRNOO       085500017102
 SAGE   1 09677    F004C 77777  1
0960000DEPOT    INDLB                              CHPOO       085800017263
0960000K3110    INDLB                              DTLOO       080000017112
0960001DEPOT F004D10            F004D              77777 S950  100000018511
             F004C05 DELETE   F004C
  BPE   1 12377   RF004C 55555  7
  QUI   1 12377    F004D 44444  5
  QUI   1 12477    F004C 33333 10
1240001DEPOT F004E04            F004E              77777 S900  160400020063
 SAGE   1 12477    F004D 77777  4
  BPO   1 12477   RF004C 66666  6
1240001K3110RF004C13           RF004C              99999 A600  124200018244
1240000DEPOT    INDLB                              TRNOO       083700017126
1240002DEPOT F004E04            F004E              66666 S600  095300012223
1240001K3160 F004E10            F004E              12345 B600  083200016581
  BPO   2 12477    F004D 77777  1
1240002K3160 F004E10            F004E              22222 F800  080800017492
1240003K3160 F004E10            F004E              66666 F600  095600017382
             F004E04 DELETE   F004E
1250001K3110 F004C11            F004C              12345 C600  111700018181
```

APPENDIX F

QUALITY CONTROL OUTPUT PER TYPE OF INSPECTION: OUTPUT

QUALITY CONTROL OUTPUT
FOR EACH TYPE OF INSPECTION

TYPE OF INSPECTION	001
NUMBER OF INSPECTIONS THIS MONTH MAR	1
TOTAL NUMBER OF DISCREPANCIES	6
RATE (DISCREPANCIES / INSPECTIONS)	6.00

```
                                  ..................................................
                                  .  J   F   M   A   M   J   J   A   S   O   N   D .
                                  ..................................................
                                  .  -   -   -   -   -   -   -   -   -   -   -   - .
UPPER CONTROL LIMIT           10  .------------------------------------------------.
                                  .  -   -   -   -   -   -   -   -   -   -   -   - .
                                  .  -   X   X   -   -   -   -   -   -   -   -   - .
COMPUTED        CHAR           4  .--X---------------------------------------------.
                                  .  -   -   -   -   -   -   -   -   -   -   -   - .
                                  .  -   -   -   -   -   -   -   -   -   -   -   - .
LOWER CONTROL LIMIT           -2  .------------------------------------------------.
                                  .  -   -   -   -   -   -   -   -   -   -   -   - .
                                  ..................................................
```

APPENDIX G

QUALITY CONTROL OUTPUT PER WORK UNIT CODE: OUTPUT

QUALITY CONTROL OUTPUT
FOR ALL TYPES OF INSPECTIONS FOR HAR

WORK UNIT CODE	NOMENCLATURE	NUMBER OF DISCREPANCIES	PERCENTAGE OF ALL DISCREPANCIES
33333	RADIO	10	0.286
11111	RADAR	9	0.257
99999	FLEX-TUBE	6	0.171
66666	LND-GEAR	3	0.086
22222	HLC-SWITCH	2	0.057
55555	NLG-ASS	2	0.057
77777	GRYO-COMP	2	0.057
88888	EJCT-SEAT	1	0.029

APPENDIX H

NUMBER OF FAILURES PER WORK UNIT CODE: OUTPUT

NUMBER OF FAILURES FOR MAR

RANK	WORK UNIT CODE	NOMENCLATURE	NUMBER OF FAILURES
1	11111	RADAR	3
2	66666	LND-GEAR	3
3	33333	RADIO	2
4	44444	ENG-MNFOLD	2
5	77777	GRYO-COMP	2
6	99999	FLEX-TUBE	2
7	22222	OLC-SWITCH	1
8	88888	EJCT-SEAT	1

APPENDIX I

NUMBER OF ABORTS PER WORK UNIT CODE: OUTPUT

NUMBER OF ABORTS FOR MAR

RANK	WORK UNIT CODE	NOMENCLATURE	NUMBER OF ABORTS
1	12345	LD-EOF-FLP	1
2	22222	MLG-SWITCH	1
3	55555	NLG-ASS	1
4	66666	LND-GEAR	1

APPENDIX J

MANHOURS EXPENDED PER WORK UNIT CODE: OUTPUT

MAN-HOURS EXPENDED FOR MAR

RANK	WORK UNIT CODE	NOMENCLATURE	TOTAL MAN-HOURS
1	66666	LND-GEAR	144.88
2	77777	GRYO-COMP	90.13
3	99999	FLEX-TURE	86.42
4	11111	RADAR	74.05
5	44444	ENG-MNFOLD	49.17
6	22222	BLC-SWITCH	28.77
7	33333	RADIO	26.78
8	12345	LD-EGE-FLP	22.40
9	88888	EJCT-SEAT	18.55
10	55555	NLG-ASS	5.87

APPENDIX K

FAILURE RATE SUMMARY PER WORK UNIT CODE: OUTPUT

FAILURE RATE SUMMARY FOR MAR

WORK UNIT CODE	NOMENCLATURE	FAILURES LAST MONTH	FAILURES THIS MONTH	RANK LAST MONTH	RANK THIS MONTH	ABORTS LAST MONTH	ABORTS THIS MONTH	RANK LAST MONTH	RANK THIS MONTH	MAN-HOURS LAST MONTH	MAN-HOURS THIS MONTH	RANK LAST MONTH	RANK THIS MONTH
11111	RADAR	1	3	7	1	0	0	0	0	8.92	74.05	7	4
12345	LD-ESE-FLP	2	0	5	0	0	1	0	1	54.73	22.40	5	8
22222	ELC-SWITCH	3	1	2	7	0	1	0	2	60.28	28.77	3	6
33333	RADIO	1	2	8	3	0	0	0	0	8.15	26.78	8	7
44444	ENG-MNFOLD	1	2	9	4	0	0	0	0	6.88	49.17	9	5
55555	MLG-ASS	6	0	1	0	0	1	0	3	94.78	5.87	2	10
66666	LND-GEAR	3	3	3	2	0	1	0	4	25.60	144.88	6	1
77777	GRYO-COMP	2	2	6	5	0	0	0	0	59.35	90.13	4	2
88888	EJCT-SEAT	1	1	10	0	0	0	0	0	5.40	18.55	10	9
99999	FLEX-TUBE	3	2	4	6	0	0	0	0	99.40	86.42	1	3

APPENDIX L

PRODUCTION SUMMARY: OUTPUT

PRODUCTION SUMMARY FOR BASE FOR MAR

MDS	SERIAL NO.	M/H USED	M/H AUTH	M/H LEFT	M/H OVER
F004C	F004C03	98.42	300	201.58	0.00
F004D	F004D06	24.58	400	375.42	0.00
F004E	F004E13	39.03	500	460.97	0.00
RF004C	RF004C13	53.27	600	546.73	0.00

APPENDIX M

MANPOWER ACCOUNTING SUMMARY PER WORK CENTER: OUTPUT

MANPOWER ACCOUNTING SUMMARY PER WORKCENTER FOR MAR

WORKCENTER	DIRECT LABOR		INDIRECT LABOR		OTHER LABOR		AUTHORIZED MANNING	ASSIGNED MANNING	PERCENT MANNED
	MANHOURS	COST	MANHOURS	COST	MANHOURS	COST			
DEPOT	274.02	229850	62.98	86760	12159.00	499984	77	71	0.922
K3110	21.58	744171	0.00	738368	4202.42	794751	22	24	1.091
K3130	15.47	314163	46.33	284574	3634.20	14780	25	21	0.840
K3160	85.60	447124	0.00	730368	1674.40	525819	10	10	1.000
K4110	110.67	321674	36.10	120113	7421.23	53164	53	43	0.811
K4210	33.02	817183	9.32	289884	1716.87	144013	9	10	1.111

APPENDIX N

LISTING OF MDCS SUBROUTINES

GETJUL	For retrieval of julian date limits
DELETE	For storage of delete data
QCRPT	For storage of QC data
FAIL	For storage of failure data
MHRA	For storage of AF form 349 data
PROD	For storage of production summary data
ABRT	For storage of abort data
LIMIT	For checks on report dates
GRAPH	For output of QC graphs
LIMITX	For checks on report dates
TYPECHK	Holds data on aircraft types
ROADNC	For quarterly reports
LIMITZ	For output of monthly reports
MNTHLY	For printing monthly reports
EOF	Positions files
PUTJUL	Updates julian dates
PREP	Establishes new julian date limits
QTCHK	Checks for quarterly report applicability
MAINT	Maintains QC file data
PARE	Monitors the reports
FAILR	Prints Monthly Failure Report
ABORTR	Prints Monthly Abort Report
MANHR	Prints the Monthly Manhour Report
FAM	Controls the previous three subroutines

LASTHIS	Updates the Summary File
FRS	Liaison for the Summary File
FSUM	Prints the Summary Report
UNIQUE	Compares summary data
PRODELT	Maintains the Production File
PSFB	Prints the Production Summary
LIMITP	Controls Six Month Maintenance Routine
FMAINT	File Maintenance
MDSPWC	Prints Cost Report
SORT1	Sorts Work Unit Code
SORT1A	Monitors the sort routine
SORT1B	Rebuilds output file

APPENDIX O

TIME DISTRIBUTIONS

Start	Probability	Finish	Probability
0400	.02	0000	.02
0500	.03	0100	.01
0600	.05	0200	.02
0700	.10	0300	.03
0800	.40	0400	.02
0900	.10	1100	.03
1000	.05	1200	.04
1100	.05	1300	.05
1200	.05	1400	.05
1300	.04	1500	.05
1400	.03	1600	.20
1500	.03	1700	.20
1600	.03	1800	.10
1700	.02	1900	.05
		2000	.05
		2100	.04
		2200	.02
		2300	.02

APPENDIX P

MANPOWER ASSIGNMENTS PER WORK CENTER

K3110 Repair Reclament Shop	Authorized	Assigned
Major	01	00
Lieutenant	01	01
Master Sergeant	01	01
Technical Sergeant	03	05
Sergeant	05	04
Airman	11	13

K3130 Electrical Shop	Authorized	Assigned
Lieutenant	01	00
Warrant Officer	01	01
Master Sergeant	02	02
Technical Sergeant	03	03
Sergeant	04	03
Airman	13	11
Civilian	01	01

K3160 Fuel System Shop	Authorized	Assigned
Master Sergeant	01	01
Technical Sergeant	01	01
Sergeant	02	03
Airman	06	05

K4110 Flight Line Support Shop	Authorized	Assigned
Captain	01	00
Lieutenant	01	01
Warrant Officer	01	04
Master Sergeant	05	07
Technical Sergeant	08	07
Sergeant	10	04
Airman	27	20

K4230 Electronic Navigation Shop	Authorized	Assigned
Warrant Officer	01	00
Master Sergeant	01	02
Technical Sergeant	01	01
Sergeant	02	00
Airman	03	06
Civilian	01	01

Depot Depot Maintenance Facility	Authorized	Assigned
Major	01	01
Captain	02	01
Lieutenant	04	03
Warrant Officer	04	05
Master Sergeant	06	06
Technical Sergeant	10	10
Sergeant	15	15
Airman	35	30

APPENDIX Q

LISTING OF MDCS PROGRAM

```
@@NORM,R(XL)1,8,16
$:IDENT:WP1191,AFIT/LSG      CALLAHAN & PAYNE  THESIS
$:OPTION:FORTRAN,NOMAP
$:USE:.GTLIT
$:FORTY:NFORM,NLNO,ASCII,NLSTIN
C
      CALL FPARAM(1,132)
C
C***********************************************************************
C***********************************************************************
C*                                                                     *
C*                          MAIN PROGRAM                               *
C*                                                                     *
C***********************************************************************
C*                                                                     *
C*                  LIST OF SUPPORTING SUBROUTINES                     *
C*                                                                     *
C----------------------------------------------------------------------*
C            GETJUL ---  RETRIEVES THE JULIAN DAY LIMIT FROM
C                        A PERMANENT FILE CALLED - JULIAN
C
C            DELETE ---  STORES ALL PROD FILE DELETE CARDS TO
C                        A PERMANENT FILE CALLED - DELETE
C
C             OCRPT ---  STORES ALL QC CARDS TO A PERMANENT FILE
C                        CALLED - QC
C
C              FAIL ---  STORES ALL FAILURE CARDS FROM ( 349 INPUTS)
C                        TO A PERMANENT FILE CALLED - FAIL
C
C              MHRA ---  STORES ALL MAN-HOUR ACCOUNTING CARDS FROM
C                        ( 349 INPUTS )TO A PERMANENT FILE CALLED -
C                        MHRACT
C
C              PROD --- STORES ALL PRODUCTION CARDS FROM ( 349 INPUTS )
C                        TO A PERMANENT FILE CALLED - PROD
C
C              ABRT --- STORES ALL ABORT CARDS FROM ( 349 INPUTS )
C                        TO A PERMANENT FILE CALLED - ABORT
C
C             LIMIT --- RETURNS THE HIGH RANGE OF INPUT JULIAN
C                        DAYS
C
C             GRAPH --- CALCULATES AND PRINTS THE QC REPORTS
C                         PER INSPECTION TYPE
C
C            LIMITX --- RETURNS THE LOW RANGE OF INPUT JULIAN
C                        DAYS
C
C           TYPECHK --- RETRIEVES AND SUPPLEMENTS THE TYPEFILE
C                        BY ADDING NEW TYPES AND RETURNING THE
C                        NUMERICAL VALUE OF EACH TYPE AND KEEPS A
C                        CONSTANT TOTAL OF ALL TYPES
C
C            LIMITZ --- RETURNS THE PARAMETER FOR THE CURRENT MONTH
C
C            MTHLY --- PRINTS THE MONTHLY QC REPORT FOR ALL
C                         TYPES OF INSPECTIONS
C
```

```
     EOF --- POSITIONS FILES AT THE END OF FILE MARK - 1

  PUTJUL --- REPLACES AND UPDATES THE JULIAN DAY WITH THE
             NEW DAY LIMIT

    PREP --- ROUNDS AN INPUTTED JULIAN DAY UPWARD TO
             ESTABLISH A NEW JULIAN DAY LIMIT

   QTCHK --- DETERMINES IF A QUARTERLY REPORT IS TO BE
             PRINTED

   MAINT --- PERFORMS MAINTENANCE ON THE QC DATA FILE

    PARI --- MONITORS AND SPAWNS MOST OF THE REPORTS

   FAILR --- PRINTS THE MONTHLY FAILURE REPORT AND
             UPDATES THE SUMMARY FILE

  ABORTR --- PRINTS THE MONTHLY ABORT REPORT AND UPDATES
             THE SUMMARY FILE

   MANHR --- PRINT THE MONTHLY MAN-HOUR REPORT AND UPDATES
             THE SUMMARY FILE

     FAM --- CONTROLS SUBROUTINES ( FAILR & ABORTR & MANHR )

 LASTHIS --- UPDATES SUMMARY FILE BY REPLACING ALL OF THE
             PREVIOUS MONTH'S VALUES WITH THE CURRENT AND
             ZEROS OUT THE CURRENT VALUES

     FRS --- LAISON FROM (FAILR & ABORTR & MANHR)TO THE
             SUMMARY FILE

LISTFILE --- WILL LIST THE CONTENTS OF ANY FILE IN
             THIS SYSTEM AT ANY POINT YOU DESIRE


    FSUM --- PRINTS THE SUMMARY REPORT FOR FAILURES, ABORTS
             AND MANHOURS WITH THE CURRENT AND PREVIOUS
             RANK

  UNIQUE --- PAIRS AND SINGLES THE SUMMARY FILE TO INDIVIDUAL
             WORK UNIT CODES AND TALLIES THE CURRENT AND
             PREVIOUS RANKS AND VALUES FOR THE SUMMARY FILE

 PRODELT --- PERFORMS MAINTENANCE ON PRODUCTION FILE BY
             PAIRING WITH THE DELETE FILE

    PSEQ --- PRINTS THE PRODUCTION SUMMARY FOR THE BASE

  LIMITP --- CONTROLS THE SIX MONTH MAINTENANCE ROUTINE - FMAI

   FMAINT --- PERFORMS THE SIX MONTH MAINTENANCE ON THE FAILURE
             FILE AND THE ABORT FILE

  MOSPWC --- CALUCATES AND PRINTS THE COST REPORT FOR THE WORK
             CENTERS

   SORTI --- ACCEPTS THE INPUT PARAMETERS FOR SORT PROCESSING
```

```
C           SORT1A --- MONITORS AND CONTROLS THE MAIN SORT ROUTINE
C
C           SORT1B --- MAIN SORT AND REBUILDS OUTPUT FILE
C
C*******************************************************************
C
C*
      CALL ATTACH(25,"77A77/CREATE2;",1,0,ISTAT,)
      CALL RSTAT(ISTAT,$15)
      CALL ATTACH(20,"77A77/QC;",3,0,ISTAT,)
      CALL RSTAT(ISTAT,$16)
      CALL ATTACH(22,"77A77/ABORT;",3,0,ISTAT,)
      CALL RSTAT(ISTAT,$17)
      CALL ATTACH(23,"77A77/FAIL;",3,0,ISTAT,)
      CALL RSTAT(ISTAT,$18)
      CALL ATTACH(24,"77A77/MHRACT;",3,0,ISTAT,)
      CALL RSTAT(ISTAT,$19)
      CALL ATTACH(29,"77A77/PROD;",3,0,ISTAT,)
      CALL RSTAT(ISTAT,$20)
      CALL ATTACH(27,"77A77/FILE27;",3,0,ISTAT,)
      CALL RSTAT(ISTAT,$21)
      CALL ATTACH(10,"77A77/TYPEFILE;",3,0,ISTAT,)
      CALL RSTAT(ISTAT,$22)
      CALL ATTACH(11,"77A77/MONEY;",1,0,ISTAT,)
      CALL RSTAT(ISTAT,$23)
      CALL ATTACH(12,"77A77/MANPOWER;",1,0,ISTAT,)
      CALL RSTAT(ISTAT,$24)
      CALL ATTACH(13,"77A77/MDSMNHRS;",1,0,ISTAT,)
      CALL RSTAT(ISTAT,$25)
      CALL ATTACH(14,"77A77/SCRATCH;",3,0,ISTAT,)
      CALL RSTAT(ISTAT,$26)
      CALL ATTACH(15,"77A77/TEMP15;",3,0,ISTAT,)
      CALL RSTAT(ISTAT,$27)
      CALL ATTACH(16,"77A77/SUMMARY;",3,0,ISTAT,)
      CALL RSTAT(ISTAT,$28)
      CALL ATTACH(17,"77A77/TEMP17;",3,0,ISTAT,)
      CALL RSTAT(ISTAT,$29)
      CALL ATTACH(18,"77A77/TEMP18;",3,0,ISTAT,)
      CALL RSTAT(ISTAT,$30)
      CALL ATTACH(19,"77A77/WORKCODE;",1,0,ISTAT,)
      CALL RSTAT(ISTAT,$31)
      CALL ATTACH(21,"77A77/DELETE;",3,0,ISTAT,)
      CALL RSTAT(ISTAT,$32)
      CALL ATTACH(28,"77A77/JULIAN;",3,0,ISTAT,)
      CALL RSTAT(ISTAT,$33)
      CALL ATTACH(09,"77A77/TYPERAND;",3,1,ISTAT,)
      CALL RSTAT(ISTAT,$34)
      CALL RANSIZ(09,60)
C---------------------------------------------------
C
C     FILENAMES    AND    CODES
C     -------------------------
C     TYPEFILE               10
C     MONEY                  11
C     MANPOWER               12
C     MDSMNHRS               13
C     SCRATCH                14
C     TEMP15                 15
C     SUMMARY                16
C     TEMP17                 17
```

```
C     TEMP10                 18
C     WORKCODE               19
C     QC                     20
C     DELETE                 21
C     ABORT                  22
C     FAIL                   23
C     MURACT                 24
C     CREATE1                25
C     FILE27                 27
C     JULIAN                 28
C     PROD                   29
C
C     -----------------------
C
C-----------------------------------------------------
C
C     VARIABLES USED   AND   MEANINGS
C     -----------------------------
C     CARD               INPUT RECORDS
C     I                 RECORD COUNTER
C     JUL                  JULIAN DAY
C     REC                IMAGE OF CARD
C     JUL3               UPPER LIMIT FOR INPUT JULIAN DATES
C     JUL4               LOWER LIMIT FOR INPUT JULIAN DATES
C     MNTS               CARRIES THE NAME OF THE CURRENT MONTH
C     -----------------------------
C
C-----------------------------------------------------
C
C     SUBROUTINES CALLED FROM - MAINLINE
C     --------------------------------
C     GETJUL
C     IDENT
C     DELETE   (USING REC)
C     QCRPT   (USING REC)
C     FAIL   (USING REC)
C     MURA   (USING REC)
C     PROD   (USING REC)
C     ABRT   (USING REC)
C     EOF
C     ---------------------------------
C
C-----------------------------------------------------
C
C-----------------------------------------------------
C ***************************************************
C *                                                 *
C *        UNIQUE   SYSTEM   ROUTINES               *
C *        ------------------------                 *
C *                                                 *
C *  1.  FPARAM -- EXTENDS PRINTER'S CARRIAGE       *
C *                                                 *
C *  2.  ATTACH -- OPENS SPECIFIED FILE WITH        *
C *               PERMISSIONS SPECIFIED IN CALL     *
C *                       NOTE THE PARAMETERS       *
C * (FILECODE,"FILE-NAME;",PERMISSIONS,TYPE,STATUS) *
C *                                                 *
C *  4.  DSTAT -- RETURNS STATUS OF ATTACH          *
C *                                                 *
C *  5.  DETACH -- CLOSES SPECIFIED FILE            *
```

```
C *                                                          *
C *  6.  STOP (W/COMMENT)-- PRINTS ERROR MESSAGES            *
C *                                                          *
C *  7.  ENCODE -- VARIABLE WRITE                            *
C *          (INTO,7001)FROM                                 *
C *      7001 FORMAT(USING THE SIZE OF INTO)                 *
C *                                                          *
C ************************************************************
C-------------------------------------------------------------
C
C-------------------------------------------------------------
C
      COMMON IXI,NJUL,KJUL,I7M,JUL,JUL3,JUL4,MNTS
      REWIND 25
      CHARACTER CARD*80,MNTS*3
      DO 1 I = 1,99999
       READ(25,7001,END=2)CARD
       WRITE(27,7001)CARD
C      FILECODES 22 --- ABORT
C                27 --- TEMPORARY
    1 CONTINUE
      STOP "NO THAN 99999 RECORDS"
    2 REWIND 27
      I = I - 1
      REWIND 25
      CALL DETACH(25,,)
C*
      CALL GETJUL
      CALL IDENT
      CHARACTER REC*1(80)
      CALL EOF
      I7M = 0
C**************************************************
C   I7M - REMEMBERS WHETHER TO PUT A DATA         *
C           BACK INTO THE STORAGE(INPUT)FILE      *
C**************************************************
    3 READ(27,7002,END=14)REC
C**************************************************
       IF(REC(22).EQ."D".AND.REC(23).EQ."E".AND.REC(24).
     &EQ."L".AND.REC(25).EQ."E".AND.REC(26).EQ.
     &"T".AND.REC(27).EQ."E")GO TO 8
       IF(REC(59).EQ." ")GO TO 4
       GO TO 5
    4 IF(REC(4).EQ." ".AND.REC(5).EQ." ".AND.
     &REC(6).EQ." ".AND.REC(7).EQ." ".OR.
     &REC(4).EQ."0".AND.REC(5).EQ."0".AND.
     &REC(6).EQ."0".AND.REC(7).EQ."0")GO TO 11
    5 IF(REC(59).EQ."S")GO TO 12
    6 IF(REC(59).EQ."A")GO TO 13
    7 IF(REC(59).EQ."C")GO TO 13
       IF(REC(59).NE."A".AND.REC(59).NE."C".AND.
     &REC(59).NE."S".AND.REC(59).NE." ")GO TO 10
       GO TO 9
C**************************************************
    8 CALL DELETE(REC)
       GO TO 3
    9 CALL NCRPT(REC)
       GO TO 3
   10 CALL FAIL(REC)
       GO TO 3
```

```
   11 CALL PURA(REC)
      GO TO 3
   12 CALL PROD(REC)
      GO TO 3
   13 CALL ARRT(REC)
      GO TO 3
C
C............................................
   14 REWIND 10
      REWIND 11
      REWIND 12
      REWIND 13
      REWIND 14
      REWIND 15
      REWIND 16
      REWIND 17
      REWIND 18
      REWIND 19
      REWIND 20
      REWIND 21
      REWIND 22
      REWIND 23
      REWIND 24
      REWIND 27
      REWIND 28
      REWIND 29
C............................................
C
      CALL LISTFILE(20)
      CALL LISTFILE(21)
      CALL LISTFILE(22)
      CALL LISTFILE(23)
      CALL LISTFILE(24)
      CALL LISTFILE(28)
      CALL LISTFILE(29)
      CALL LISTFILE(16)
      CALL LISTFILE(10)
      CALL DETACH(10,,)
      CALL DETACH(11,,)
      CALL DETACH(12,,)
      CALL DETACH(13,,)
      CALL DETACH(14,,)
      CALL DETACH(15,,)
      CALL DETACH(16,,)
      CALL DETACH(17,,)
      CALL DETACH(18,,)
      CALL DETACH(19,,)
      CALL DETACH(20,,)
      CALL DETACH(21,,)
      CALL DETACH(22,,)
      CALL DETACH(23,,)
      CALL DETACH(24,,)
      CALL DETACH(27,,)
      CALL DETACH(28,,)
      CALL DETACH(29,,)
C
      CALL IDENT
      STOP "NORMAL TERMINATION"
C-----------------------------------------------------------
C
```

```
   15 STOP "NO ATTACH-AAC\CALL-MAINLINE"
   16 STOP "NO ATTACH-QC-MAINLINE"
   17 STOP "NO ATTACH-ABORT-MAINLINE"
   18 STOP "NO ATTACH-FAIL-MAINLINE"
   19 STOP "NO ATTACH-MHRACT-MAINLINE"
   20 STOP "NO ATTACH-PROD-MAINLINE"
   21 STOP "NO ATTACH-FILE27-MAINLINE"
   22 STOP "NO ATTACH-TYPEFILE-MAINLINE"
   23 STOP "NO ATTACH-MONEY-MAINLINE"
   24 STOP "NO ATTACH-MANPOWER-MAINLINE"
   25 STOP "NO ATTACH-MOSMHHRS-MAINLINE"
   26 STOP "NO ATTACH-SCRATCH-MAINLINE"
   27 STOP "NO ATTACH-TEMP15-MAINLINE"
   28 STOP "NO ATTACH-SUMMARY-MAINLINE"
   29 STOP "NO ATTACH-TEMP17-MAINLINE"
   30 STOP "NO ATTACH-TEMP18-MAINLINE"
   31 STOP "NO ATTACH-WORKCODE-MAINLINE"
   32 STOP "NO ATTACH-DELETE-MAINLINE"
   33 STOP "NO ATTACH-JULIAN-MAINLINE"
   34 STOP "NO ATTACH-TYPEHAND-MAINLINE"
C
C-------------------------------------------------------------
 7001 FORMAT(A80)
 7002 FORMAT(8A8)
      END
C
C
C
      SUBROUTINE ABORTR(I)
C      FILECODE 18 --- TEMPORARY
C
C-------------------------------------------------------------
C
C            NOTES AND COMMENTS ABOUT ROUTINE
C            --------------------------------
C   NAME - ABORTR
C   INPUT ARGUMENT - I
C   VARIABLES USED -  WUCX
C                     NOMEN
C                     C59
C                     I
C                     J
C                     K
C                     IABORTX
C                     IFAILX
C                     TOTMANX
C   CALLED FROM - FAM
C   SUPPORTING SUBROUTINES - ERS
C
C   DESCRIPTION OF VARIABLES
C   ------------------------
C   WUCX - WORK UNIT CODE
C   NOMEN - NOMENCLATURE FOR WORK UNIT CODE
C   C59 - WHEN DISCOVERED CODE
C   I - NUMBER OF WORK UNIT CODES
C   J - RANK OF WORK UNIT CODE
C   K - LOOP INCREMENT AND POINTER
C   IABORTX - NUMBER OF ABORTS
C   IFAILX - NUMBER OF FAILURES
C   TOTMANX - NUMBER OF MAN-HOURS
```

```
C     ----------------------------------------
C
C     CONSTANT USED - 2
C     -----------------
C                         THE ABOVE CONSTANT TELLS
C                         FRS THAT AN ABORT IS BEING
C                         PROCESSED
C
C--------------------------------------------------------
C
      COMMON IXT,NJUL,KJUL,IZM,JUL,JUL3,JUL4,MNTS
      CHARACTER WUCX*5,NOMEN*10,C59*1,MNTS*3
C*******************************************************
C*                                                     *
C* PRINT THE HEADING INCLUDING CURRENT MONTH FOR      *
C*             NUMBER OF ABORTS REPORT                 *
C*                                                     *
C*******************************************************
C
      PRINT 7005
      PRINT," "
      PRINT 7001,MNTS
      PRINT," "
      PRINT," "
      PRINT 7002
      PRINT 7003
      PRINT 7002
      REWIND 10
      J = 0
C
C*******************************************************
C*                                                     *
C*    IPRNT IS SET TO (0)ZERO... IF A RECORD IS       *
C*  PRINTED THEN IT IS CHANGED TO ONE.   THIS IS A    *
C*  PARAMETER USED TO DETERMINE WHETHER TO PRINT      *
C*  THE NO ABORTS MESSAGE.                             *
C*                                                     *
C*******************************************************
      IPRNT = 0
C
      DO 2 K = 1,I
       READ(10,2007,END=3)C59,WUCX,NOMEN,IABORTX,IFAILX,TOTMANX
       IF(IABORTX.EQ.0)GO TO 2
    1  IPRNT = 1
C********************************************************
C*     J = THE RANK FOR ABORTS                          *
C********************************************************
       J = J + 1
       PRINT 7004,J,WUCX,NOMEN,IABORTX
       IFAILX = 0
       TOTMANX = 0.00
       CALL FRS(J,WUCX,NOMEN,IABORTX,IFAILX,TOTMANX,2)
       PRINT 7000
    2 CONTINUE
C
C
C**********************************************************
C*    IF NO ABORTS PRINTED / PRINT NO ABORTS MESSAGE      *
C**********************************************************
C
```

```
      IF(IPRNT.EQ.0)PRINT 7006
    3 CONTINUE
      PRINT 7002
      RETURN
C
 7001 FORMAT(T45,"NUMBER OF  ABORTS FOR ",A3,/)
 7002 FORMAT(T26,64("*"))
 7003 FORMAT(T26,"* RANK  * WORK UNIT CODE *  NOMENCLATURE",
     &" *  NUMBER OF  ABORTS  *")
 7004 FORMAT(T26,"*",1X,I5,1X,"*",6X,A5,5X,"*",4X,
     &A10,1X,"*",9X,I4,8X,"*")
 7005 FORMAT(1H1)
 7006 FORMAT(T26,"*",62X,"*",/,T26,"*",16X,
     &"NO ABORTS REPORTED THIS MONTH ",16X,"*",/,
     &T26,"*",62X,"*")
 7007 FORMAT(A1,1X,A5,1X,A10,1X,I4,1X,I4,1X,F6.2)
 7008 FORMAT(T26,"*",T34,"*",T51,"*",T62,"*",T89,"*")
      END
C
C
C
      SUBROUTINE ABRT(REC)
C--------------------------------------------------------
C
C                   NOTES AND COMMENTS ABOUT ROUTINE
C                   --------------------------------
C   NAME - ABRT
C   INPUT ARGUMENT - REC
C   VARIABLES USED - JDAY
C                    JUL
C                    KEC
C                    REC
C   CALLED FROM - MAINLINE
C   SUPPORTING SUBROUTINES - PREP
C
C   DESCRIPTION OF VARIBLES
C   -----------------------
C   JDAY - JULIAN DAY FROM INPUT RECORD
C   JUL - JULIAN DAY LIMIT
C   KEC - SINGLE IMAGE OF REC
C   REC - INPUT RECORD
C   MNTS - CURRENT MONTH
C   JUL3 - UPPER LIMIT OF INPUT JULIAN DATES
C   JUL4 - LOWER LIMIT OF INPUT JULIAN DATES
C   --------------------------------------
C
C--------------------------------------------------------
C
      COMMON IXT,NJUL,KJUL,I7M,JUL,JUL3,JUL4,MNTS
      CHARACTER REC*1(80),KEC*80
C* GET JULIAN DAY
      ENCODE(KEC,7001)REC
      DECODE(KEC,7002)JDAY
      IF(JDAY.GE.JUL4.AND.JDAY.LE.JUL3.AND.JUL.GT.32)GO TO 1
      GO TO 2
C* UPDATE FILE
    1 WRITE(22,7001)REC
      I7M = 1
      RETURN
    2 JUL = JDAY
```

```
      CALL PREP
      BACKSPACE 27
      RETURN
 2001 FORMAT(80A1)
 2002 FORMAT(I3)
      END
C
C
C
      SUBROUTINE DELETE(REC)
C
C-------------------------------------------------------------
C
C               NOTES AND COMMENTS ABOUT ROUTINE
C               --------------------------------
C   NAME - DELETE
C   INPUT ARGUMENT - REC
C   VARIABLES USED - I
C                    JUL
C                    BEC
C                    REC
C                    IFC
C   CALLED FROM - MAINLINE
C
C   DESCRIPTION OF VARIABLES
C   ------------------------
C   I - LOOP COUNTER AND POINTER
C   JUL - JULIAN DAY LIMIT
C   BEC - BLANK
C   REC - INPUT RECORD
C   IFC - FILE RECORD
C   ----------------------------
C
C-------------------------------------------------------------
C
      COMMON IXT,NJUL,KJUL,IZH,JUL,JUL3,JUL4,MNTS
C      FILECODE 21 --- DELETE
      CHARACTER IFC*80,BEC*80/" "/
      CHARACTER MNTS*3
      CHARACTER REC*1(80)
      BEC = " "
C
C
C**************************************************************
C*      READ DELETE CARD FILE TO THE END                      *
C**************************************************************
C
      DO 1 I = 1,99999
       READ(21,2001,END=2)IFC
       IF(IFC.EQ.BEC)GO TO 2
    1 CONTINUE
C
      STOP "ERROR ON FILE DELETE"
C
C**************************************************************
C*                     ADD  A  NEW  RECORD                    *
C**************************************************************
C
    2 BACKSPACE 21
      WRITE(21,2001)REC
```

AD-A044 212 AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OHIO SCHO--ETC F/G 5/1
A REQUIREMENTS STUDY FOR AN AUTOMATED MAINTENANCE DATA COLLECTI--ETC(U)
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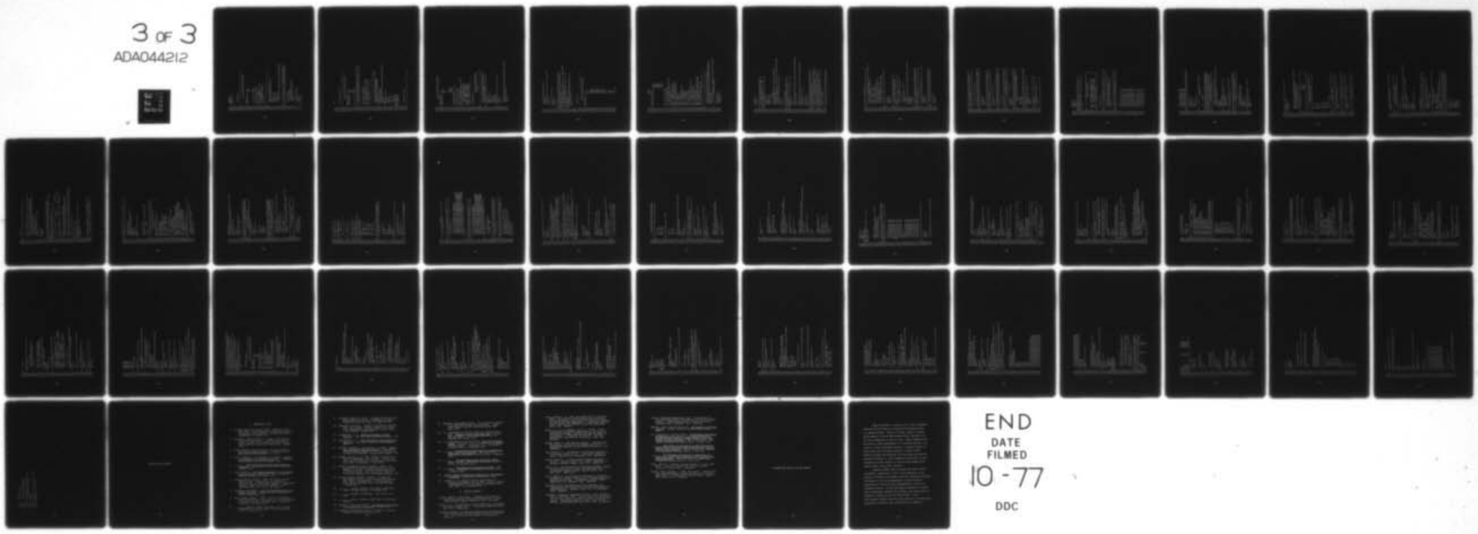
UNCLASSIFIED AFIT-LSSR-24-77A NL

3 OF 3
ADA044212



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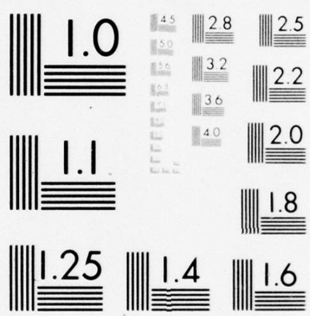

MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS-1963-A

```
      REWIND 21
      RETURN
 7001 FORMAT(80A1)
      END
C
C
C
      SUBROUTINE EOF
C
C-----------------------------------------------------------
C
C            NOTES AND COMMENTS ABOUT ROUTINE
C            --------------------------------
C
C    NAME - EOF
C    VARIABLES USED - CARD
C                     FILES
C                     I
C                     J
C                     REC
C    CALLED FROM - MAINLINE
C
C    DESCRIPTION OF VARIABLES
C    ------------------------
C    CARD - FILE RECORD
C    FILES - FILECODES TO BE READ
C    I - POINTER FOR FILES
C    J - LOOP POINTER AND INDEX
C    REC - BLANK
C    ----------------------------
C
C-----------------------------------------------------------
C
      CHARACTER CARD*80,REC*80/" "/
      INTEGER FILES(5)/20,22,23,24,29/
      REC = " "
      FILES(1) = 20
      FILES(2) = 22
      FILES(3) = 23
      FILES(4) = 24
      FILES(5) = 29
C      FILECODES (20-OC,22-ABORT,23-FAIL,24-NURACT,29-PROD)
C
C
C**********************************************************
C*      SET FILES TO EOF - 1 / SO DATA CAN BE ENTERED    *
C**********************************************************
C
      DO 3 I = 1,5
       REWIND FILES(I)
       DO 1 J = 1,99999
        READ(FILES(I),7001,END=2)CARD
        IF(CARD.EQ.REC)GO TO 2
    1  CONTINUE
C
       STOP "EOF - NO EOF"
    2  BACKSPACE FILES(I)
    3 CONTINUE
      RETURN
 7001 FORMAT(A80)
```

```
      END
C
C
C
      SUBROUTINE FAIL(REC)
C
C------------------------------------------------------------
C
C              NOTES AND COMMENTS ABOUT ROUTINE
C              --------------------------------
C    NAME - FAIL
C    INPUT ARGUMENT - REC
C    VARIABLES USED - JDAY
C                     JUL
C                     KEC
C                     REC
C    CALLED FROM - MAINLINE
C
C*****************************************************************
C*       SUBROUTINE THAT SUPPORT THIS -    PREP                  *
C*****************************************************************
C
C
C    DESCRIPTION OF VARIABLES
C    ------------------------
C    JDAY - JULIAN DAY FROM INPUT RECORD
C    JUL  - JULIAN DAY LIMIT
C    KEC  - SINGLE IMAGE OF INPUT RECORD
C    REC  - INPUT RECORD
C    ----------------------------------
C
C------------------------------------------------------------
C
      COMMON IXT,JJUL,KJUL,IZM,JUL,JUL3,JUL4,MNTS
C      FILECODES (23-FAIL,27-TEMPORARY)
      CHARACTER REC*1(80),KEC*80,MNTS*3
C*GET JULIAN DAY
      ENCODE(KEC,7001)REC
      DECODE(KEC,7002)JDAY
      IF(JDAY.GE.JUL4.AND.JDAY.LE.JUL3.AND.JUL.GT.32)GO TO 1
      GO TO 2
C* UPDATE FILE
    1 WRITE(23,7003)KEC
      IZM = 1
      RETURN
    2 JUL = JDAY
      CALL PREP
C*
      BACKSPACE 27
      RETURN
 7001 FORMAT(80A1)
 7002 FORMAT(I3)
 7003 FORMAT(A80)
      END
C
C
C
      SUBROUTINE FAILR(I)
C
C------------------------------------------------------------
```

```
C
C          NOTES AND COMMENTS ABOUT ROUTINE
C          --------------------------------
C   NAME - FAILR
C   INPUT ARGUMENT - I
C   VARIABLES USED - WUCX
C                    NOMEN
C                    C59
C                    I
C                    J
C                    K
C                    IABORTX
C                    IFAILX
C                    TOTMANX
C   CALLED FROM - FAM
C   SUPPORTING SUBROUTINES - FRS
C
C   DESCRIPTION OF VARIABLES
C   ------------------------
C   WUCX - WORK UNIT CODE
C   NOMEN - NOMENCLATURE OF WORK UNIT CODE
C   C59 - WHEN DISCOVERED CODE
C   I - NUMBER OF WORK UNIT CODES
C   J - RANK OF WORK UNIT CODE
C   K - LOOP INCREMENT AND POINTER
C   IABORTX - NUMBER OF ABORTS
C   IFAILX - NUMBER OF FAILURES
C   TOTMANX - NUMBER OF MAN-HOURS
C   ----------------------------------------
C
C   CONSTANT USED - 1
C   -----------------
C                    THE ABOVE CONSTANT TELLS
C                    FRS THAT A FAILURE IS BEING
C                    PROCESSED
C
C--------------------------------------------------------------
C
      COMMON IXT,MJUL,KJUL,IZM,JUL,JUL3,JUL4,MNTS
      CHARACTER WUCX*5,NOMEN*18,C59*1,MNTS*3
C      FILECODE (18-TEMPORARY)
C*********************************************
      PRINT 7007
      PRINT," "
      PRINT 7003,MNTS
      PRINT," "
      PRINT," "
      PRINT 7004
      PRINT 7005
      PRINT 7004
C*********************************************
      REWIND 18
      J = 0
      IPRNT = 0
C
      DO 1 K = 1,I
       READ(18,7001,END=2)C59,WUCX,NOMEN,IABORTX,IFAILX,TOTMANX
       IF(IFAILX.EQ.0)GO TO 1
       IPRNT = 1
       J = J + 1
```

```
      PRINT 7006,J,NUCX,NOMEN,IFAILX
      IABORTX = 0
      IOTMANX = 0
      CALL FAS(J,NUCX,NOMEN,IABORTX,IFAILX,IOTMANX,1)
      PRINT 7002
    1 CONTINUE
C
      IF(IPRNT.EQ.0)PRINT 7008
    2 CONTINUE
      PRINT 7004
      RETURN
C
 7001 FORMAT(A1,1X,A5,1X,A10,1X,I4,1X,I4,1X,F6.2)
 7002 FORMAT(T26,"*",T34,"*",T51,"*",T67,"*",T89,"*")
 7003 FORMAT(T45,"NUMBER OF FAILURES FOR ",A3,/)
 7004 FORMAT(T26,64("*"))
 7005 FORMAT(T26,"* RANK  * WORK UNIT CODE *  NOMENCLATURE",
     &" *  NUMBER OF FAILURES *")
 7006 FORMAT(T26,"*",1X,I5,1X,"*",6X,A5,5X,"*",4X,
     &A10,1X,"*",9X,I4,8X,"*")
 7007 FORMAT(1H1)
 7008 FORMAT(T26,"*",62X,"*",/,T26,"*",14X,
     &"NO FAILURES REPORTED THIS MONTH ",14X,"*",/,
     &T26,"*",62X,"*")
      END
C
C
C
      SUBROUTINE FAM
C
C----------------------------------------------------
C
C           NOTES AND COMMENTS ABOUT ROUTINE
C           --------------------------------
C   NAME - FAM
C   VARIABLES USED - C59
C                    C59X
C                    I
C                    I10
C                    IABORT
C                    IBOTH
C                    IBOTHS
C                    ICHEM
C                    ICHEMS
C                    IEACH
C                    IEACHS
C                    EACHS
C                    IFAILS
C                    IGO
C                    IGONE
C                    ISTART
C                    ISTOP
C                    J
C                    JUL
C                    JUL2
C                    JUL3
C                    JUL4
C                    JULS
C                    K
C                    NOMENX
```

```
C                          IOTMAN
C                          WUC
C                          WUCX
C     CALLED FROM - PARE
C     SUPPORTING SUBROUTINES - LIMIT
C                              LIMITX
C                              SORT1
C                              FAILR
C                              ABORTP
C                              MANHR
C                              UNIQUE
C                              ESUM
C                              LASTHIS
C
C     DESCRIPTION OF VARIABLES
C     ------------------------
C     C59 - WHEN DISCOVERED CODE
C     C59X - WHEN DISCOVERED CODE ACCUMULATOR
C     I - POINTER AND INDEX FOR JOBS
C     IIO - FILE MONITOR
C     IABORT - ABORTS ACCUMULATOR
C     IBOTH - TEMPORARY HOURS COUNTER
C     IBOTHS - TEMPORARY MINUTES COUNTER
C     ICREW - CREW SIZE ACCUMULATOR
C     ICREWS - CREW SIZE
C     IEACH - HOURS
C     IEACHS - MINUTES
C     EACHS - MINUTES (REAL)
C     IFAIL - FAILURES ACCUMULATOR
C     IGO - START MINUTES
C     IGONE - STOP MINUTES
C     ISTART - START HOURS
C     ISTOP - STOP HOURS
C     J - POINTER AND INDEX
C     JUL - JULIAN DAY LIMIT
C     JUL2 - JULIAN DAY FROM INPUT OR FILE
C     JUL3 - JULIAN DAY LIMIT - 1
C     JUL4 - JULIAN DAY LIMIT - 2
C     JOBS - FILECODES TO BE READ
C     K - POINTER AND INDEX
C     NOMENX - NOMENCLATURE OF WORK UNIT CODE
C     IOTMAN - MANHOURS (FROM EACHS AND IEACH)
C     WUC - WORK UNIT CODE
C     WUCX - WORK UNIT CODE ACCUMULATOR
C     ----------------------------------------
C
C-----------------------------------------------------
C
      COMMON IXT,NJUL,KJUL,IZM,JUL,JUL3,JUL4,MNTS
      CHARACTER WUCX*5,NOMENX*10,C59*1,WUC*5(100),C59X*1(100)
      INTEGER IABORT(100),IFAILS(100),ICREW(100),JOBS(3)/23,22,29/
      REAL IOTMAN(100)
      CHARACTER MNTS*3
C      FILECODES (17-TEMPORARY,18-TEMPORARY,22-ABORT,23-FAIL,29-PROD)
C                (14-SCRATCH,16-SUMMARY)
      IIO = 0
      DO 1 KB = 1,100
       IABORT(KB) = 0
       IFAILS(KB) = 0
       IOTMAN(KB) = 0.0
```

```
       ICREW(20) = 0
     1 CONTINUE
       REWIND 10
C
C*********************************************
C*        MERGE THE FAILURES,ABORTS, & PROD   *
C*  FILES TOGETHER TO PRODUCE THE FAILURE    *
C*  RATE SUMMARY REPORT.                      *
C*********************************************
     2 DO 4 J = 1,3
        JOBS(1) = 23
        JOBS(2) = 22
        JOBS(3) = 29
        REWIND JOBS(J)
C
        DO 3 I = 1,99999
         READ(JOBS(J),7002,END=4)JUL2,WUCX,C59,ISTART,IDO,
     &ISTOP,IGONE,ICREWS
         IF(JUL2.LT.JUL3.AND.JUL2.GE.JUL4)WRITE(10,7001)WUCX,C59,ISTART
     &,IDO,ISTOP,IGONE,ICREWS
         IF(JUL2.LT.JUL3.AND.JUL2.GE.JUL4)II0 = 1
     3  CONTINUE
C
     4 CONTINUE
C
       IF(II0.EQ.0)RETURN
C*********************************************
C*       SCAN MERGE FILE PULLING UNIQUE      *
C*  WORK-CENTERS.                            *
C*********************************************
       REWIND 10
       I = 0
       I = I + 1
       READ(10,7001,END=10)WUC(I),C59X(I),ISTART,IDO,ISTOP,IDONE,ICREW(I)
       ICREWS = ICREW(I)
       J = 1
       GO TO 7
     5 READ(10,7001,END=10)WUCX,C59,ISTART,IDO,ISTOP,IDONE,ICREWS
       DO 6 J = 1,I
        IF(WUCX.EQ.WUC(J))GO TO 7
     6 CONTINUE
       I = I + 1
       WUC(I) = WUCX
       C59X(I) = C59
       J = I
C******************************************************
C*  IF COLUMN (59)OF AF349 IS "A" OR "C" ADD 1 TO    *
C* THE NUMBER OF ACCUMULATED ABORTS.                  *
C******************************************************
     7 IF(C59.EQ."A".OR.C59.EQ."C")IABORT(J) = IABORT(J)+ 1
       IF(C59.EQ."A".OR.C59.EQ."C")GO TO 8
C******************************************************
C*  IF COLUMN (59)OF AF349 IS NOT "A" OR "C" ADD 1   *
C* TO THE NUMBER OF ACCUMULATED FAILURES.             *
C******************************************************
       IFAILS(J) = IFAILS(J)+ 1
     8 ICREW(J) = ICREWS
C
C******************************************************
C*    COMPUTE USING THIS TIME PHASE THE MAN-HOURS FOR *
```

```
C* EACH TYPE OF WORK-UNIT-CODE.                                  *
C****************************************************************
C
      IF(ISTOP.LE.ISTART.AND.IGONE.LE.100)ISTOP = ISTOP + 24
      IF(IGONE.LT.100)ISTOP = ISTOP - 1
      IF(IGONE.LT.100)IGONE = IGONE + 64
      IBOTH = ISTOP - ISTART
      IBOTHS = IGONE - 100
      IEACH = IBOTH * ICREW(J)
      IEACHS = IBOTHS * ICREW(J)
    9 IF(IEACHS.GE.60)IEACH = IEACH + 1
      IF(IEACHS.GE.60)IEACHS= IEACHS - 60
      IF(IEACHS.GE.60)GO TO 9
      IF(IEACHS.GT.0)EACHS = (IEACHS / 60.)
      TOTMAN(J) = TOTMAN(J)+  (IEACH + EACHS)
C
C****************************************************************
C
      GO TO 5
   10 REWIND 18
      REWIND 17
      REWIND 19
C
C**********************************************
C*       READ THE WORK-UNIT CODE FILE &       *
C*    MATCH IT AGAINST THE UNIQUES FOUND      *
C*    ABOVE...                                *
C**********************************************
      DO 13 K = 1,99999
       READ(19,7003,END=14)WUCX,NOMENX
C
       DO 11 L = 1,I
        IF(WUCX.EQ.WUC(L))GO TO 12
   11  CONTINUE
       GO TO 13
   12  WRITE(17,7004)C59X(L),WUC(L),NOMENX,IABORT(L),IFAILS(L),
     &TOTMAN(L)
   13 CONTINUE
       REWIND 19
   14 REWIND 17
C
C****************************************************************
C*   SORT FILE BY NUMBER OF FAILURES (DESCENDING) & *
C*  WRITE TO FILECODE 18.                                        *
C****************************************************************
C
       CALL SORT1(17,35,1,8,25,4,1,18)
C******************************************************************
       REWIND 18
       REWIND 14
       REWIND 16
C
C****************************************************************
C*       THE SUBROUTINE FAILR EXTRACTS FAILURE DATA        *
C****************************************************************
C
   15 CALL FAILR(I)
       REWIND 17
       REWIND 18
C
```

```
05100C*************************************************************
05105C*   SORT FILE BY NUMBER OF ABORTS (DESCENDING)&            *
05110C*  WRITE TO FILECODE 18.                                    *
05115C*************************************************************
05120C
05125       CALL SORT1(17,35,1,0,20,4,1,18)
05130C
05135C*****************************************************************
05140C*   THE SUBROUTINE ABORTR EXTRACTS DATA FOR ABORTS             *
05145C*****************************************************************
05150C
05155       CALL ABORTR(I)
05160       REWIND 17
05165       REWIND 18
05170C
05175C*************************************************************
05180C*   SORT FILE BY NUMBER OF MAN-HOURS (DESCENDING)& *
05185C*  WRITE TO FILECODE 18.                                   *
05190C*************************************************************
05195C
05200       CALL SORT1(17,35,1,0,30,6,1,18)
05205       REWIND 18
05210C
05215C*****************************************************************
05220C*   THE SUBROUTINE MANHR EXTRACTS MAN-HOUR DATA                *
05225C*****************************************************************
05230C
05235       CALL MANHR(I)
05240C
05245C*****************************************************************
05250C*  THIS DUMMY CALL TO ERS CAUSE TOTALS TO BE TALLIED.  *
05255C*                      AND CLOSE THE FILE                      *
05260C*****************************************************************
05265C
05270       CALL ERS(1," "," ",0,0,0,0,4)
05275       REWIND 14
05280       REWIND 16
05285C*****************************************************************
05290C************************************************************
05295C*   GET THE UNIQUE WORK-UNIT-CODES AND PRODUCE THE  *
05300C*         REPORTS FOR THE FAILURE RATE SUMMARY       *
05305C*                                                    *
05310       CALL UNIQUE
05315       CALL LSUM
05320       CALL LASTHIS
05325C*****************************************************************
05330C************************************************************
05335       REWIND 17
05340C**************************************************
05345C*      WRITE EOF MARK TO CLOSE                    *
05350       ENDFILE 17
05355       REWIND 17
05360C*                                                 *
05365C**************************************************
05370       REWIND 18
05375C**************************************************
05380C*      WRITE EOF MARK TO CLOSE                    *
05385       REWIND 18
05390C*                                                 *
05395C**************************************************
```

```
      REWIND 22
      REWIND 23
      REWIND 29
      RETURN
 7001 FORMAT(A5,1X,A1,5X,I2,I2,3X,I2,I2,I1)
 7002 FORMAT(I3,49X,A5,1X,A1,5X,I2,I2,3X,I2,I2,I1)
 7003 FORMAT(A5,1X,A10)
 7004 FORMAT(A1,1X,A5,1X,A10,1X,I4,1X,I4,1X,F6.2)
      END
C
C
C.......................................................
C.                 VARIABLE EXPLANATION               .
C.                 --------------------               .
C.                                                    .
C.   JUL3 -- HIGH RANGE OF CURRENT JULIAN DAY         .
C.   JUL2 -- JULIAN DAY FROM INPUTFILE                .
C.   JUL8 -- HIGH RANGE OF MAINTENANCE PERIOD         .
C.   JUL9 -- LOW  RANGE OF MAINTENANCE PERIOD         .
C.   I14  -- FILE CONTROL MONITOR                     .
C.......................................................
C
C
      SUBROUTINE EMAINT
C
C.........................................................
C.              CALLED FROM ------- P  A  R  F          .
C.........................................................
C
      COMMON IXT,NJUL,KJUL,I7M,JUL,JUL3,JUL4,MNTS
      CHARACTER REST*73,MNTS*3,CARD*80
C.      FILECODES (22-ABORT,23-FAIL,14-SCRATCH)
      CARD = " "
C
C.........................................................
C.      ESTABLISH  THE MAINTENANCE PERIOD               .
C.........................................................
C
C
      JUL8 = 0
      IF(JUL3.EQ.31)JUL8 = 243
      IF(JUL3.EQ.59)JUL8 = 273
      IF(JUL3.EQ.90)JUL8 = 304
      IF(JUL3.EQ.120)JUL8 = 334
      IF(JUL3.EQ.151)JUL8 = 366
      IF(JUL3.EQ.181)JUL8 = 031
      IF(JUL3.EQ.212)JUL8 = 059
      IF(JUL3.EQ.243)JUL8 = 090
      IF(JUL3.EQ.273)JUL8 = 120
      IF(JUL3.EQ.304)JUL9 = 151
      IF(JUL3.EQ.334)JUL8 = 181
      IF(JUL3.EQ.366)JUL8 = 212
      JUL9 = 0
      IF(JUL3.EQ.31)JUL9 = 213
      IF(JUL3.EQ.59)JUL9 = 244
      IF(JUL3.EQ.90)JUL9 = 274
      IF(JUL3.EQ.120)JUL9 = 305
      IF(JUL3.EQ.151)JUL9 =335
      IF(JUL3.EQ.181)JUL9 = 001
      IF(JUL3.EQ.212)JUL9 = 032
```

```
      IF(JUL3.EQ.243)JUL9 = 060
      IF(JUL3.EQ.273)JUL9 = 091
      IF(JUL3.EQ.304)JUL9 = 121
      IF(JUL3.EQ.334)JUL9 = 152
      IF(JUL3.EQ.366)JUL9 = 182
C*******************************************************
C****************************************************
C
      INTEGER MFILE(2)
      MFILE(1) = 22
      MFILE(2) = 23
      DO 5 I = 1,2
       I14 = 0
       REWIND 14
       REWIND MFILE(I)
C
C******    READ FILE - IF DATE IS WITHIN THE RANGE...
C                        DO NOT SAVE.
C
       DO 1 J = 1,99999
C
C****************************************************
C* READ A DATA RECORD... IF THE DATE IS GREATER THAN *
C* OR EQUAL TO THE LOWER LIMIT AND THE DATE IS LESS  *
C* THAN OR EQUAL TO THE UPPER LIMIT AND THE JULIAN   *
C* DAY IS GREATER THAN 32...CONTINUE READING FILE -  *
C*            DO NOT SAVE THIS RECORD.                *
C****************************************************
C
        READ(MFILE(I),7001,END=2)JUL2,REST
        IF(JUL2.GE.JUL9.AND.JUL2.LE.JUL8.AND.JUL.GT.32)GO TO 1
        WRITE(14,7001)JUL2,REST
        I14 = 1
    1  CONTINUE
    2  REWIND 14
       REWIND MFILE(I)
C*****************************************
C*      WRITE EOF MARK TO CLOSE          *
      ENDFILE MFILE(I)
      REWIND MFILE(I)
C*                                       *
C*****************************************
       IF(I14.EQ.0)GO TO 5
C
C****************************************************
C*  WRITE ALL RECORDS BACK TO THE PERMFILE THAT WERE *
C*            SAVED WITH PROPER DATE RANGES.          *
C****************************************************
C
       DO 3 K = 1,99999
        READ(14,7001,END=4)JUL2,REST
        WRITE(MFILE(I),7001)JUL2,REST
    3  CONTINUE
    4  REWIND 14
       REWIND MFILE(I)
    5 CONTINUE
C*****************************************
C*      WRITE EOF MARK TO CLOSE          *
      ENDFILE 14
      REWIND 14
```

```
C*                                                *
C**************************************************
      RETURN
 2001 FORMAT(I3,A73)
 2002 FORMAT(A80)
      END
C
C
C
      SUBROUTINE FRS(J,WUCX,NOMEN,IABORIX,IFAILX,TOTMANX,I59)
      CHARACTER WUCX*5,NOMEN*10,WUC*5,NOM*10
      REAL TOTMANX,KKK,LLL,IML,IMT
C      FILECODES (16-SUMMARY,14-SCRATCH)
      TOTMANX = TOTMANX
C*******************************************************
C*      CALLED FROM ------------- F A M               *
C*                                FAILR               *
C*                                ABORTR              *
C*                                MANHR               *
C*******************************************************
C
C***************************************************
C*      SET ALL VARIABLES THAT ARE USED IN THE     *
C*              IN THE TRANSFER TO ZERO            *
C***************************************************
C
      IFL = 0
      IFT = 0
      IFRT = 0
      IFRL = 0
      IAL = 0
      IAT = 0
      IARL = 0
      IART = 0
      IML = 0.0
      IMT = 0.0
      IMRL = 0
      IMRT = 0
      GO TO(1,2,3,4),I59
C
C***************************************************
C*                 WRITE A FAILURE                 *
C***************************************************
C
    1 WRITE(14,2001)WUCX,NOMEN,IFL,IFAILX,IFRL,J,IAL,
     &IAT,IARL,IART,IML,IMT,IMRL,IMRT
      RETURN
C
C***************************************************
C*                 WRITE AN ABORT                  *
C***************************************************
C
    2 WRITE(14,2001)WUCX,NOMEN,IFL,IFT,IFRL,IFRT,IAL,
     &IABORIX,IARL,J,IML,IMT,IMRL,IMRT
      RETURN
C
C***************************************************
C*                WRITE A MAN-HOUR                 *
C***************************************************
C
```

```
    3 WRITE(14,7001)WUCX,NOMEN,IFL,IFT,IFRL,IFRT,IAL,IAT,
     &IARL,IART,IML,IOTMANX,IMRL,J
      RETURN
C
C*************************************************************
C*                  ADD ALL DATA RECORDS FROM                *
C*           THE SUMMARY FILE TO FILECODE 14                 *
C*************************************************************
C
    4 REWIND 16
C
      DO 5 IR = 1,99999
       READ(16,7001,END=6)WUC,NOM,II,JJ,KK,LL,MM,NN,III,JJJ,KKK,LLL,
     &MMM,NNN
       WRITE(14,7001)WUC,NOM,II,JJ,KK,LL,MM,NN,III,
     &JJJ,KKK,LLL,MMM,NNN
    5 CONTINUE
C
    6 REWIND 14
      REWIND 16
      RETURN
 7001 FORMAT(A5,A10,8I4,2F6.2,2I4)
      END
C
C
C
      SUBROUTINE FSUM
C*************************************************************
C*        CALLED FROM ----------  F  A  M                    *
C*************************************************************
C
      COMMON IXT,NJUL,KJUL,I7M,JUL,JUL3,JUL4,MNTS
      CHARACTER WUC*5,NOMEN*10,MNTS*3
      REAL J9,J0
C      FILECODE (16-SUMMARY)
C
C*************************************************************
C*                 VARIABLE EXPLANATION                      *
C*                 --------------------
C*    WUC - WORK-UNIT-CODE
C*    NOMEN - NOMENCLATURE
C*    MNTS - CURRENT MONTH NAME
C*    J1 THROUGH J0 -- VALUES IN SUMMARY FILE
C*************************************************************
      REWIND 16
C*************************************************************
C*            PRINT HEADING FOR FAILURE SUMMARY REPORT
C*************************************************************
C*************************************************************
C
      PRINT 7010
      PRINT," "
      PRINT 7002,MNTS
      PRINT," "
      PRINT," "
      PRINT 7008
      PRINT 7003
      PRINT 7007
      PRINT 7004
      PRINT 7005
```

```
      PRINT 2007
C
C************************************************************
C
C
      DO 2 I = 1,99999
    1 READ(16,7001,END=3)WUC,NOMEN,J1,J2,J3,J4,J5,J6,J7,J8,J9,JA
     &,JA,JB
      IF(J1.EQ.0.AND.J2.EQ.0.AND.J3.EQ.0.AND.J4.EQ.0.AND.
     &  J5.EQ.0.AND.J6.EQ.0.AND.J7.EQ.0.AND.J8.EQ.0.AND.
     &  J9.EQ.0.0.AND.J0.EQ.0.0.AND.JA.EQ.0.AND.JB.EQ.0)GO TO 1
      IF(J9.EQ.0.0)J9 = J9 +.001
      IF(J0.EQ.0.0)J0 = J0 + .001
      PRINT 2006,WUC,NOMEN,
     &J1,J2,J3,J4,J5,J6,J7,J8,J9,J0,JA,JB
    2 CONTINUE
C
    3 PRINT 2007
      REWIND 16
      RETURN
C*
C*
C************************************************************
C*  THIS IS THE FORMATS FOR THE FAILURE RATE SUMMARY
C********************************************************************
C*
 7001 FORMAT(A5,A10,814,2F6.2,214)
 7002 FORMAT(T51,"FAILURE RATE SUMMARY FOR ",A3,/)
C*
 7003 FORMAT(T32,"*   FAILURES    *      RANK       *     ABORTS",
     &"     *       RANK        * MAN-HOURS    *       RANK       *",/)
C*
 7004 FORMAT(1X,"*",14X,"*",T32,"*LAST      THIS * LAST      THIS * ",
     &"LAST      THIS * LAST      THIS * LAST      THIS * LAST       ",
     &"THIS  *")
C*
 7005 FORMAT(1X,"*WORK UNIT CODE* NOMENCLATURE  ",
     &T32,"*MONTH   MONTH *MONTH    MONTH *MONTH    MONTH * ",
     &"MONTH   MONTH * MONTH   MONTH * MONTH   MONTH  *")
C*
 7006 FORMAT(1X,"*",T6,A5,T17,"*",T20,A10,T32,"*",1X,I4,3X,I4,2X,"*",
     &1X,I3,6X,I3,2X,"*",1X,I4,4X,I4,2X,"*",2X,I3,5X,I3,2X,"*",1X,F6.2,2
     &X,
     &F6.2,"*",2X,I3,5X,I3,3X,"*")
C*
 7007 FORMAT(1X,127("*"))
C*
 7008 FORMAT(1X,T12,97("*"))
 7009 FORMAT(T26,"*",1X,A5,1X,"*",6X,I5,5X,"*",4X,
     &A10,1X,"*",9X,I4,9X,"*")
 7010 FORMAT(1H1)
      END
C
C
C
C
C***********************************************************
C*       CALLED   FROM THE ------------- MAINLINE         *
C*   -----------------------------------------------      *
C*   THE MANDATORY PURPOSE OF THIS ROUTINE IS TO PRO-     *
```

```
C*    VIDE THE CURRENT RANGE OF THE JULIAN SINCE THE        *
C*    LAST UPDATE.                                          *
C************************************************************
C
      SUBROUTINE GETJUL
C      FILECODE (20-JULIAN)
      COMMON IXT,NJUL,KJUL,IZM,JUL,JUL3,JUL4
      READ(20,2001)JUL,IXT,NJUL,KJUL
      REWIND 20
      CALL LIMIT
      CALL LIMITX
      RETURN
 2001 FORMAT(I3,1X,I3,1X,I3,1X,I3)
      END
C
C
C
      SUBROUTINE GRAPH
      COMMON IXT,NJUL,KJUL,IZM,JUL,JUL3,JUL4,MNTS
C
C      FILECODE    (20-OC)
C
C***********************************************************
C*      CALLED FROM ------------------   P  A  R  F        *
C*   ---------------------------------------------------   *
C*                 VARIABLES EXPLAINED HERE                 
C*                                                         *
C*   TYPES = INSPECTION TYPE                               *
C*   TYPE = CUMULATIVE INSPECTION TYPE                     *
C*   MDS = MDS                                             *
C*   WUC = WORK-UNIT-CODE
C*   INNER GRAPH MATRIX
C*   POINT (PLOTTED POINT)
C*   MX = OUTER BOUNDARIES OF GRAPH
C*   MNTS = CURRENT MONTH NAME
C*   RR = RATE OF PREVIOUS MONTHS
C*   RTID = RATE OF CURRENT MONTH
C*    RIC = CHAR
C*   RTD = RATE OF CURRENT (RTID)
C*   RR = RATE SAVE MATRIX
C*   M = TOTAL = TOTAL TYPES OF INSPECTION
C* I12 = FILE CONTROL MONITOR
C*   N = PER TYPE NUMBER CODE
C*   JJT = PER TYPE NUMBER CODE
C*   KOUNT = NUMBER OF INSPECTIONS PER QUARTER
C*   LOUNT = NUMBER OF INSPECTIONS PER MONTH
C*   JTOTDIS = NUMBER OF DISCREPANCIES THIS QUARTER
C*   KTOTDIS - NUMBER OF DISCREPANCIES THIS MONTH
C*   JUL2 = JULIAN DATE FROM INPUTFILE
C*   JUL3 = CURRENT JULIAN DAY HIGH RANGE
C*   JUL4 = CURRENT JULIAN DAY LOW RANGE
C*   NC = CURRENT MONTH NUMBER VALUE
C*   ND = RENAMES NC
C*   KF = GRAPH CONTROL POINTER
C************************************************************
C
       CHARACTER TYPE*5(100),TYPES*5,MDS*7,WUC*5
       CHARACTER MX*1(7,12),STAR*1/"X"/
       CHARACTER D(*1(12,12)
       CHARACTER MNTS*3
```

```
      INTEGER RRR
      CHARACTER MON*3(12)/"JAN","FEB","MAR","APR","MAY","JUN",
     &"JUL","AUG","SEP","OCT","NOV","DEC"/
      REAL RTID,RIC
      INTEGER RID,RR(12,100)
      M = 0
      REWIND 20
      I12 = 0
    1 READ(20,7007,END=2)TYPES,JUL2
      IF(TYPES.EQ." ")GO TO 1
      I12 = 1
C
C*****************************************************
C*   CHECK TO SEE IF THIS PARTICULAR TYPE HAS BEEN   *
C* EXPERIENCED, IF IT HAS RETURN THE ASSIGNED NUMBER *
C*               ------------ OR ----------          *
C*                ADD THE NEW TYPE TO FILE           *
C*****************************************************
      CALL TYPECHK(TYPES,M,N)
      TYPE(N) = TYPES
      GO TO 1
    2 REWIND 20
      IF(I12.EQ.0)GO TO 13
      I = M
C
      DO 12 JJT = 1,I
       KOUNT = 0
       LOUNT = 0
       JTOTDIS = 0
       KTOTDIS = 0
       REWIND 20
C
C*****************************************************
C* READ QC DATAFILE AND IF THE DATE IS IN THE PROPER *
C*  RANGE AND TYPES MATCH; TOTAL THE DISCREPANCIES   *
C* FOR THE CURRENT MONTH AND THE DISCREPANCIES FOR A *
C*               THREE (3)MONTH PERIOD.              *
C*****************************************************
C
        DO 4 JTT = 1,99999
         READ(20,7008,END=5)TYPES,INSNO,JUL2,JYR,MDS,WUC,JDISP
         IF(TYPES.EQ." ")GO TO 4
         IF(JUL2.GE.JUL3)GO TO 4
         IF(TYPES.EQ.TYPE(JJT))GO TO 3
         GO TO 4
    3    JTOTDIS = JTOTDIS + JDISP
         KOUNT = KOUNT + 1
         IF(JUL2.LT.JUL3.AND.JUL2.GE.JUL4)KTOTDIS = KTOTDIS + JDISP
         IF(JUL2.LT.JUL3.AND.JUL2.GE.JUL4)LOUNT = LOUNT + 1
    4   CONTINUE
C
C*****************************************************
C*              DETERMINE WHAT MONTH IS BEING        *
C*                        REPORTED                   *
C*****************************************************
C
    5   CALL LIMIT2(MC)
        IF(LOUNT.LE.0)LOUNT = 1
        IF(KOUNT.LE.0)KOUNT = 1
        RIC = JTOTDIS / KOUNT
```

```
C****************************
C*         IC = CBAR        *
C****************************
        IC = BIC
C****************************
C*   IUCL = UPPER CONTROL   *
C*          LIMIT           *
C****************************
C
        IUCL = IC + 3 * IC ** .5
C
C*  ILCL = LOWER CONTROL *
C*         LIMIT         *
C*************************
C
        ILCL = IC - 3 * IC ** .5
C****************************
C*      RTID = RATE         *
C****************************
C****************************
        RTID = (KTOTDIS * 1. / LOUNT)
C****************************
C* NB = MONTH BEING PRINTED*
C****************************
        NB = NC
        RR(NC,JJT) = RTID
        RTD = RTID
        LUCL = IUCL - IC
        LUCL = LUCL / 2
        JUCL = IUCL - LUCL
        KUCL = IC + LUCL
        LLCL = IC - ILCL
        LLCL = LLCL / 2
        KLCL = IC - LLCL
        JLCL = ILCL + LLCL
C
C*****************************************************
C*    SET GRAPH POSITIONS BACK TO ZERO AND DASHES    *
C*****************************************************
        DO 7 IAO = 1,12
C
         DO 6 JAO = 1,7
          HX(JAO,IAO) = "-"
    6    CONTINUE
C
    7   CONTINUE
        DO 9 KAO = 1,12
         DO 8 HAO = 1,2
          UX(HAO,KAO) = "-"
    8    CONTINUE
    9   CONTINUE
C*****************************************************
C
        IF(JLCL.EQ.KLCL)JLCL = ILCL + 1
        IF(JUCL.EQ.KUCL)KUCL = JUCL - 1
        JMT = JJT
        IF(NC.EQ.1)GO TO 11
        ND = NC - 1
C*****************************************************
C*    RETRIEVE THE PLOTTED VALUES SAVED AS PROGRAM   *
```

```
C*                         PROGRESSES                          *
C***************************************************************
      CALL TYPERAND(JMT,RR,ND,1)
C
C
C*****************************************************************
C*       PLOT   PREVIOUS MONTHS       HERE  .                    *
C*****************************************************************
      DO 10 KE = 2,NC
       RRR = RR(KE - 1,JJT)
C
       IF(RRR.LT.ILCL)ENCODE(BX(2,KE -1),7006)STAR
       IF(RRR.EQ.ILCL)ENCODE(MX(7,KE-1),7006)STAR
       IF(RRR.GT.ILCL.AND.RRR.LE.JLCL)ENCODE(MX(6,KE-1),7006)STAR
       IF(RRR.GT.JLCL.AND.RRR.LE.KLCL)ENCODE(MX(5,KE-1),7006)STAR
       IF(RRR.GT.KLCL.AND.RRR.LE.IC)ENCODE(MX(4,KE-1),7006)STAR
       IF(RRR.GT.IC.AND.RRR.LE.KUCL)ENCODE(MX(3,KE-1),7006)STAR
       IF(RRR.GT.KUCL.AND.RRR.LE.JUCL)ENCODE(MX(2,KE-1),7006)STAR
       IF(RRR.GT.JUCL.AND.RRR.LE.IUCL)ENCODE(MX(1,KE-1),7006)STAR
       IF(RRR.GT.IUCL)ENCODE(BX(1,KE-1),7006)STAR
   10 CONTINUE
C
C
C*****************************************************************
C*    SAVE CURRENT MONTHS VALUE TO RANDOM FILE                   *
C*****************************************************************
C
   11 IF(RID.LT.ILCL)ENCODE(BX(2,NB),7006)STAR
      IF(RID.EQ.ILCL)ENCODE(MX(7,NB),7006)STAR
      IF(RID.GT.ILCL.AND.RID.LE.JLCL)ENCODE(MX(6,NB),7006)STAR
      IF(RID.GT.JLCL.AND.RID.LE.KLCL)ENCODE(MX(5,NB),7006)STAR
      IF(RID.GT.KLCL.AND.RID.LE.IC)ENCODE(MX(4,NB),7006)STAR
      IF(RID.GT.IC.AND.RID.LE.KUCL)ENCODE(MX(3,NB),7006)STAR
      IF(RID.GT.KUCL.AND.RID.LE.JUCL)ENCODE(MX(2,NB),7006)STAR
      IF(RID.GT.JUCL.AND.RID.LE.IUCL)ENCODE(MX(1,NB),7006)STAR
      IF(RID.GT.IUCL)ENCODE(BX(1,NB),7006)STAR
C*****************************************************************
      RR(NC,JJT) = RID
C
      CALL TYPERAND(JMT,RR,NC,2)
      IF(KIOIDIS.EQ.0)LOUNT = 0
      RIID = RIID + .001
C
C*****************************************************************
C*    IF    CHAR IS EQUAL TO ZERO (0)DO NOT PRINT GRAPH  *
C*****************************************************************
       IF(IC.EQ.0)GO TO 13
C
C*****************************************************************
C*    PRINT THE GRAPH >>>>>>><<<<<<< PRINT THE GRAPH     *
C*****************************************************************
C
       PRINT 7001,TYPE(JJT),MON(MB),LOUNT
       PRINT 7002,KIOIDIS,RIID
       PRINT 7003,(BX(1,J),J = 1,12),IUCL,
     &(MX(1,J),J=1,12),(MX(2,J),J = 1,12)
       PRINT 7004,(MX(3,J),J=1,12),
     &IC,(MX(4,J),J=1,12),
     &(MX(5,J),J=1,12),
     &(MX(6,J),J=1,12)
```

```
      PRINT 2005,ILCL,(HX(7,J),J=1,12),(HX(2,J),J = 1,12)
   12 CONTINUE
C
   13 CONTINUE
      MNTS = MON(MD)
      RETURN
C* * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C* THIS IS THE FORMAT FOR THE QUALITY CONTROL REPORT     *
 7001 FORMAT(1H1,T50,"QUALITY CONTROL OUTPUT",/,
     &T47,"FOR EACH TYPE OF INSPECTION",//,
     &/,T31,"TYPE OF INSPECTION",T85,A8,//,
     &T31,"NUMBER OF INSPECTIONS THIS MONTH",1X,A3,T80,I5,//)
 7002 FORMAT(T31,"TOTAL NUMBER OF DISCREPANCIES",T80,I5,//,
     &T31,"RATE (DISCREPANCIES / INSPECTIONS)",T80,F13.2,///,
     &T31,62("*"),/,
     &T31,"*  J    F    M    A    M    J    J    A    S    O",
     &"    N    D  *",/)
 7003 FORMAT(T31,62("*"),/,T20,11X,"*",12("  ",A1,"  "),T92,"*",
     &/T1,"UPPER CONTROL LIMIT",I10,1X,"*",12("--",A1,"--"),"*",/,
     &T20,10X,1X,"*",12("  ",A1,"  "),T92,"*")
 7004 FORMAT(T20,10X,1X,"*",12("  ",A1,"  "),T92,"*",/,
     &T1,"COMPUTED       CBAR ",I10,1X,"*",12("--",A1,"--"),"*",/,
     &T20,10X,1X,"*",12("  ",A1,"  "),T92,"*",/,
     &T20,10X,1X,"*",12("  ",A1,"  "),T92,"*",/)
 7005 FORMAT(T1,"LOWER CONTROL LIMIT",I10,1X,"*",12("--",A1,"--"),"*",/,
     &T20,11X,"*",12("  ",A1,"  "),T92,"*",/,T31,62("*"))
 7006 FORMAT(A1)
 7007 FORMAT(A5,4X,I3)
 7008 FORMAT(A5,1X,I2,1X,I3,I2,1X,A7,1X,A5,1X,I2)
      END
C
C
C
      SUBROUTINE IDENT
      DO 1 I = 1,55
       PRINT 7001
    1 CONTINUE
      RETURN
 7001 FORMAT(10("*")," CALLAHAN & PAYNE THESIS ",40("*"))
      END
C
C
C
      SUBROUTINE LASTHIS
      CHARACTER WUCX*5,NOMEN*10,CARD*63
      REAL IML,IMT
C      FILECODES (15-TEMPORARY,16-SUMMARY)
      REWIND 15
      REWIND 16
      I15 = 0
C
      DO 1 I = 1,99999
       READ(16,7001,END=2)WUCX,NOMEN,IFL,IFT,IFRL,IFRT,IAL,
     &IAT,IARL,IART,IML,IMT,IMRL,IMRT
       IF(WUCX.EQ." ")GO TO 2
C*
C*  IF ALL VALUES ARE ZERO DO NOT SAVE TO SUMMARY
C*
       IF(IFL.EQ.0.AND.IFT.EQ.0.AND.IAL.EQ.0.AND.
     &   IAT.EQ.0.AND.IARL.EQ.0.AND.IART.EQ.0.AND.
```

```
     &    IFRL.EQ.0.AND.IFRT.EQ.0.AND.IML.EQ.0.AND.
     &    IMT.EQ.0.AND.IMRL.EQ.0.AND.IMRT.EQ.0)GO TO 1
C*
C*  SAVE THIS MONTH'S VALUES TO LAST MONTH'S VALUES
C*
        IFL = IFT
        IFRL = IFRT
        IAL = IAT
        IARL = IART
        IML = IMT
        IMRL = IMRT
C*
C* RESET THIS MONTH'S VALUES TO ZERO
C*
        IFT = 0
        IFRT = 0
        IAT = 0
        IART = 0
        IMT = 0.0
        IMRT = 0
C*
        I15 = 1
        WRITE(15,7001)WUCX,MONTH,IFL,IFT,IFRL,IFRT,IAL,IAT,IARL,
     &IART,IML,IMT,IMRL,IMRT
    1 CONTINUE
C
    2 REWIND 15
      REWIND 16
      IF(I15.EQ.0)GO TO 3
C
C**************************************************************
C*   SORT FILE BY WORK-UNIT-CODE     AND                      *
C*       WRITE SORTED FILE TO SUMMARY FILE                    *
C**************************************************************
C
      CALL SORT1(15,67,1,0,1,5,0,16)
    3 REWIND 16
      REWIND 15
C*********************************************
C*       WRITE EOF MARK TO CLOSE             *
      ENDFILE 15
      REWIND 15
C*                                           *
C*********************************************
      RETURN
 7001 FORMAT(A5,A10,8I4,2F6.2,2I4)
 7002 FORMAT(A63)
      END
C
C
C
      SUBROUTINE LIMIT
      COMMON IYT,NJUL,KJUL,IZM,JUL,JUL3,JUL4,MNTS
      INTEGER LIMITS(14)/32,60,91,121,152,182,213,244,
     &274,305,335,367,032,060/
      CHARACTER MNTS*3
C
      DO 1 I = 1,14
       IF(JUL.EQ.LIMITS(I))GO TO 2
    1 CONTINUE
```

```
C
    2 JUL3 = LIMITS(I - 2)- 1
      RETURN
      END
C
C
C
      SUBROUTINE LIMITP(JUL5)
      COMMON IXT,NJUL,KJUL,IZM,JUL,JUL3,JUL4,MNTS
      CHARACTER MNTS*3
      JUL5 = 0
      IF(JUL3.EQ.212)JUL5 = 182
      IF(JUL3.EQ.366)JUL5 = 001
      RETURN
      END
C
C
C
      SUBROUTINE LIMITX
      COMMON IXT,NJUL,KJUL,IZM,JUL,JUL3,JUL4,MNTS
      INTEGER LIMITS(15)/1,32,60,91,121,152,182,213,244,
     &274,305,335,367,032,060/
      CHARACTER MNTS*3
C
      DO 1 I = 4,15
       IF(JUL.EQ.LIMITS(I))GO TO 2
    1 CONTINUE
C
    2 JUL4 = LIMITS(I - 3)
      RETURN
      END
C
C
      SUBROUTINE LIMITZ(MX)
      COMMON IXT,NJUL,KJUL,IZM,JUL,JUL3,JUL4,MNTS
      INTEGER LIMITS(12)/91,121,152,182,213,244,274,305,335,367,032,60/
      CHARACTER MNTS*3
C
      DO 1 I = 1,12
       IF(JUL.EQ.LIMITS(I))GO TO 2
    1 CONTINUE
C
    2 MX = I
      RETURN
      END
C
C
C
      SUBROUTINE LISTFILE(ICODE)
      CHARACTER DATA*120
      J = 0
      PRINT 7004
      PRINT,"FILECODE ",ICODE
      REWIND ICODE
    1 DO 2 I = 1,99999
       READ(ICODE,7001,END=3)DATA
       PRINT 7002,DATA
    2 CONTINUE
      J = J + 1
      GO TO 1
```

```
    3 J = J + 1
      PRINT 7003,J - 1
      REWIND ICODE
      RETURN
 7001 FORMAT(A120)
 7002 FORMAT(1X,A120)
 7003 FORMAT(" NUMBER OF RECORD = ",I7,/,1H1)
 7004 FORMAT(1H1)
      END
C
C
C
      SUBROUTINE MAINT
      COMMON IXT,NJUL,KJUL,I2M,JUL,JUL3,JUL4,MNTS
      CHARACTER TYPE*5,MOS*7,WUC*5
      CHARACTER CARD*80,MNTS*3
       FILECODES (20-OC,18-TEMPORARY)
C
C*******************************************************
C*   ESTABLISH THE RANGE FOR PERFORMING FILE MAINTEN-*
C*  ANCE ON THE OC DATA FILE.                          *
C*******************************************************
C
      JUL6 = 0
      IF(JUL3.EQ.031)JUL6 = 334
      IF(JUL3.EQ.059)JUL6 = 366
      IF(JUL3.EQ.090)JUL6 = 031
      IF(JUL3.EQ.120)JUL6 = 0059
      IF(JUL3.EQ.151)JUL6 = 090
      IF(JUL3.EQ.181)JUL6 = 120
      IF(JUL3.EQ.212)JUL6 = 151
      IF(JUL3.EQ.243)JUL6 = 181
      IF(JUL3.EQ.273)JUL6 = 212
      IF(JUL3.EQ.304)JUL6 = 243
      IF(JUL3.EQ.334)JUL6 = 273
      IF(JUL3.EQ.366)JUL6 = 304
      CARD = " "
      JUL7 = 0
      IF(JUL3.EQ.31)JUL7 = 305
      IF(JUL3.EQ.059)JUL7 = 335
      IF(JUL3.EQ.090)JUL7 = 001
      IF(JUL3.EQ.120)JUL7 = 032
      IF(JUL3.EQ.151)JUL7 = 060
      IF(JUL3.EQ.181)JUL7 = 091
      IF(JUL3.EQ.212)JUL7 = 121
      IF(JUL3.EQ.243)JUL7 = 152
      IF(JUL3.EQ.273)JUL7 = 182
      IF(JUL3.EQ.304)JUL7 = 213
      IF(JUL3.EQ.334)JUL7 = 244
      IF(JUL3.EQ.366)JUL7 = 274
C
C*******************************************************
C
      CARD = " "
      REWIND 20
      REWIND 18
      IIR = 0
C
      DO 1 I = 1,99999
       READ(20,7012,END=2)TYPE,INSNO,JUL2,JYR,MOS,WUC,JDISP
```

```
      IF(JUL2.GE.JUL7.AND.JUL2.LE.JUL6.AND.JUL.GT.32)GO TO 1
      WRITE(18,7002)TYPE,INSNO,JUL2,JYR,MDS,WUC,JDISP
      IIA = 1
    1 CONTINUE
C
    2 REWIND 18
      REWIND 20
      WRITE(20,7001)CARD
      REWIND 20
C**********************************************
C*      WRITE EOF MARK TO CLOSE               *
      ENDFILE 20
      REWIND 20
C*                                            *
C**********************************************
      IF(IIA.EQ.0)GO TO 4
C
      DO 3 I = 1,99999
       READ(19,7001,END=4)CARD
       WRITE(20,7001)CARD
    3 CONTINUE
C
    4 REWIND 20
      REWIND 18
C**********************************************
C*      WRITE EOF MARK TO CLOSE               *
      ENDFILE 18
      REWIND 18
C*                                            *
C**********************************************
      RETURN
 7001 FORMAT(A80)
 7002 FORMAT(A5,1X,I2,1X,I3,I2,1X,A7,1X,A5,1X,A5)
      END
C
C
C
C*****************************************************
C*                VARIABLES EXPLAINED                *
C** ----------------------------------------------- **
C*   WUCX = WORK-UNIT CODE                           *
C*   NOME = NOMENCLATURE
C*   MNTS = CURRENT MONTH NAME
C*   K = LOOP INDEX
C*   M = RANK
C*   IABORTX = NUMBER OF ABORTS
C*   FAILX = NUMBER OF FAILURES
C*   TOTMANX = TOTAL MAN-HOURS
C*****************************************************
C
C*****************************************************
C*                     CONSTANT USED                 *
C*                     -------------                 *
C*             3 = FRS PARAMETER FOR MAN-HOURS
C*****************************************************
C
      SUBROUTINE MANHR(I)
      COMMON IXI,NJUL,KJUL,I7M,JUL,JUL3,JUL4,MNTS
      CHARACTER WUCX*5,NOMEN*10,MNTS*3
       FILECODE (18-TEMPORARY)
```

```
C
C************************************************************
      PRINT 7007
      PRINT," "
      PRINT 7001,MNTS
      PRINT," "
      PRINT," "
      PRINT 7004
      PRINT 7005
      PRINT 7004
C************************************************************
C
C
      DO 1 K = 1,I
C
C************************************************************
C*      M = RANK FOR MANHR                                  *
C************************************************************
       M = K
       READ(10,7002,END=2)WUCX,NOMEN,IABORTX,IFAILX,TOTMANX
       PRINT 7006,K,WUCX,NOMEN,TOTMANX
C
C****************************************************************
C*    SAVE PRINTED VALUES FOR SUMMARY REPORT                    *
C****************************************************************
C
       CALL FRS(M,WUCX,NOMEN,IABORTX,IFAILX,TOTMANX,3)
       PRINT 7003
    1 CONTINUE
C
    2 CONTINUE
      PRINT 7004
      RETURN
 7001 FORMAT(T43,"MAN-HOURS EXPENDED FOR ",A3,/)
 7002 FORMAT(2X,A5,1X,A10,1X,I4,1X,I4,1X,F6.2)
 7003 FORMAT(T26,"*",T34,"*",T51,"*",T67,"*",T89,"*")
C*
 7004 FORMAT(T26,64("*"))
 7005 FORMAT(T26,"* RANK  * WORK UNIT CODE *  NOMENCLATURE",
     &" *  TOTAL MAN-HOURS     *")
 7006 FORMAT(T26,"*",1X,I5,1X,"*",6X,A5,5X,"*",4X,
     &A10,1X,"*",7X,F6.2,8X,"*")
 7007 FORMAT(1H1)
      END
C
C
C
      SUBROUTINE MDSPMC
      COMMON IXT,NJUL,KJUL,I7M,JUL,JUL1,JUL4,MNTS
      CHARACTER WCN*5,WCNX*5(100),RANK1*5,RANK2*5(15),WCNO*5(100)
      REAL ALLTM(100),MHRTM(100),DCOST(100),ICOST(100)
      REAL MANNING(100),DIRLB(100),INDLB(100),OTHRS(100),OTCOST(100)
      INTEGER ASSGN(100),AUTH(100),SHOPHRS(100),AUTH2,ASSGN2,CREW(100)
      INTEGER SINGSAL,TOTSAL(100),CREWS(100)
      CHARACTER MNTS*3
C      FILECODES (22-ABORT,23-FAIL,24-MHRACT,11-MONEY)
C                   (12-MANPOWER,29-PROD,14-SCRATCH)
C                  (10-TEMPORARY)
C*OFT FILES MERGE
      CHARACTER PEC*80/" "/
```

```
      INTEGER OFILE(3)/22,23,29/
C      I14 = FILE CONTROL MONITOR
      I14 = 0
      PEC = " "
      OFILE(1) = 22
      OFILE(2) = 23
      OFILE(3) = 29
C
C*****************************************************************
C*               VARIABLE        EXPLAINED                       *
C* ------------------------------------------------------------- *
C*    ALLTM = TOTAL MAN-HOURS FOR DIRECT LABOR
C*    MHRTM = TOTAL MANHOURS FOR INDIRECT LABOR
C*    ASSGN = TOTAL ASSIGNED
C*    AUTH = TOTAL AUTHORIZED
C*    SHOPHRS = TOTAL SHOP HOURS
C*    DCOST = TOTAL DIRECT LABOR COST
C*    ICOST = TOTAL INDIRECT LABOR COST
C*    MANNING = PERCENT MANNED
C*    DIRLB = DIRECT LABOR
C*    INDLB = INDIRECT LABOR
C*    OTHRS = OTHER MANHOURS
C*    OTCOST = OTHER COST
C*    CREWS = NUMBER OF CREW MEMBERS FOR DIRECT LABOR
C*    CREW NUMBER OF CREW MEMBERS FOR INDIRECT LABOR
C*    TOTSAL = TOTAL SALARY
C*****************************************************************
C
      DO 1 IN = 1,100
       ALLTM(IN) = 0.0
       MHRTM(IN) = 0.0
       ASSGN(IN) = 0
       AUTH(IN) = 0
       SHOPHRS(IN) = 0
       DCOST(IN) = 0.0
       ICOST(IN) = 0.0
       MANNING(IN) = 0.0
       DIRLB(IN) = 0.0
       INDLB(IN) = 0.0
       OTHRS(IN) = 0.0
       OTCOST(IN) = 0.0
       CREWS(IN) = 0
       CREW(IN) = 0
       TOTSAL (IN) = 0
    1 CONTINUE
C
C
C*****************************************************************
C*    MERGE FILES FINDING UNIQUE WORK-CENTERS                    *
C*****************************************************************
C
      DO 3 I=1,3
       REWIND OFILE(I)
C
       DO 2 J=1,99999
        READ(OFILE(I),7014,END=3)JUL2,WCN,ISTART,IGO,ISTOP,IDONE,ICREW
        IF(JUL2.GE.JUL3.OR.JUL2.LT.JUL4)GO TO 2
        I14 = 1
        WRITE(14,7001)WCN,ISTART,IGO,ISTOP,IDONE,ICREW
    2  CONTINUE
```

```
C
    3 REWIND OFILE(I)
C
C*   GET UNIQUE FROM 3 FILES
      REWIND 14
C
C*******************************************************
C*   IF NO APPLICABLE DATA RECORD FOUND RETURN TO PARE  *
C*******************************************************
C
      IF(I14.EQ.0)RETURN
      I=1
    4 READ(14,7001,END=9)WCNX(J),ISTART,IGO,ISTOP,IGONE,CREW(I)
      IF(WCNX(J).EQ." ")GO TO 4
      ICREW = CREW(I)
      GO TO 7
    5 READ(14,7001,END=9)WCN,ISTART,IGO,ISTOP,IGONE,ICREW
C
      DO 6 J=1,I
       IF(WCN.EQ.WCNX(J))GO TO 7
    6 CONTINUE
C
      I = I + 1
      WCNX(I) = WCN
      J = I
    7 CREW(J) = ICREW
C
C*******************************************************
C*   TIME    PHASE    FOR    DIRECT    LABOR            *
C*******************************************************
C
      IF(ISTOP.LE.ISTART.AND.IGONE.LE.IGO)ISTOP = ISTOP + 24
      IF(IGONE.LT.IGO)ISTOP = ISTOP - 1
      IF(IGONE.LT.IGO)IGONE = IGONE + 60
      IDOTH = ISTOP - ISTART
      IDOTHS = IGONE - IGO
      IEACH = IDOTH * CREW(J)
      IEACHS = IDOTHS * CREW(J)
    8 IF(IEACHS.GE.60)IEACH = IEACH + 1
      IF(IEACHS.GE.60)IEACHS = IEACHS - 60
      IF(IEACHS.GE.60)GO TO 8
      IF(IEACHS.GT.0)EACHS = (IEACHS / 60.)
C**********    TIME     *****     PHASE     *****
      ALLTM(J) = ALLTM(J)+ (IEACH + EACHS)
      GO TO 5
    9 REWIND 14
C
C*******************************************************
C*       JALL = SUBTOTAL UNIQUE WORK-CENTERS            *
C*******************************************************
C
      JALL = 1
C*GET UNIQUE FROM MHRACT
      REWIND 24
C
      DO 10 I = 1,99999
       READ(24,7014,END=11)JUL2,WCN,ISTART,IGO,ISTOP,IGONE,ICREW
       IF(JUL2.GE.JUL3.OR.JUL2.LT.JUL4)GO TO 10
       WRITE(14,7001)WCN,ISTART,IGO,ISTOP,IGONE,ICREW
   10 CONTINUE
```

```
C
   11 REWIND 24
      REWIND 14
      I = JALL
   12 READ(14,7001,END=16)WCN,ISTART,IDD,ISTOP,IGONE,ICREW
      IF(WCN.EQ." ")GO TO 12
C
C
C************************************************************
C*                 MATCH  WORK-CENTERS                       *
C************************************************************
C
      DO 13 J = 1,I
       IF(WCN.EQ.WCNX(J))GO TO 14
   13 CONTINUE
C
      I = I + 1
      WCNX(I) = WCN
      J = I
   14 CREWS(J) = ICREW
C
C************************************************************
C*         COMPUTE   TIME   PHASE FOR INDIRECT LABOR         *
C************************************************************
C
      IF(ISTOP.LE.ISTART.AND.IGONE.LE.IDD)ISTOP = ISTOP + 24
      IF(IGONE.LT.IDD)ISTOP = ISTOP - 1
      IF(IGONE.LT.IDD)IGONE = IGONE + 60
      IDOTH = ISTOP - ISTART
      IDOTHS = IGONE - IDD
      IEACH = IDOTH * CREWS(J)
      IEACHS = IDOTHS * CREWS(J)
   15 IF(IEACHS.GE.60)IEACH = IEACH + 1
      IF(IEACHS.GE.60)IEACHS = IEACHS - 60
      IF(IEACHS.GE.60)GO TO 15
      IF(IEACHS.GT.0)EACHS = (IEACHS / 60.)
C*********** TIME ******** PHASE *************
      MHRTM(J) = MHRTM(J)+ (IEACH + EACHS)
      GO TO 12
   16 REWIND 14
C
C************************************************************
C*    JMHR = TOTAL UNIQUE WORKCENTERS
C************************************************************
C
      JMHR = I
      REWIND 12
C
      DO 21 L = 1,JMHR
       KK = 1
       REWIND 12
C
C
C      COMPARE UNIQUES WITH MANPOWER FILE - IF MATCH
C     OCCURS OPEN HONEY FILE
C
       DO 20 K = 1,99999
        READ(12,7002,END=21)WCN,RANK1,AUTH2,ASSGN2
        IF(WCN.EQ.WCNX(L))GO TO 17
        GO TO 20
```

```
C
   17   REWIND 11
C
C
C     COMPARE RANK FROM MANPOWER FILE WITH MONEY TO
C     COMPUTE SALARIES
C
           DO 18 M = 1,99999
             READ(11,7003,END=20)RANK2(M),SINOSAL
             IF(RANK1.EQ.RANK2(M))GO TO 19
   18      CONTINUE
C
C
C          COMPUTE TOTAL SALARY PER WORKCENTER
C*         COMPUTE TOTAL ASSIGNED PER WORKCENTER
C          COMPUTE TOTAL AUTHORIZED PER WORKCENTER
C
   19      TOTSAL(L) = TOTSAL(L) + (ASSON2 * SINOSAL)
           ASSGN(L) = ASSGN(L)+ ASSON2
           AUTH(L) = AUTH(L)+ AUTH2
   20   CONTINUE
   21 CONTINUE
        REWIND 14
        DO 22 L = 1,KK
C
C          IF TOTAL ASSIGNED & TOTAL AUTHORIZED IS ZERO -
C     DO NOT SAVE OR REPORT FOR.
C
          IF(ASSON(L).EQ.0.AND.AUTH(L).EQ.0)GO TO 22
          SHOPHRS(L) =  (ASSON(L)* 176.)
          IF(ALLTH(L).GT.0)DIRLB(L) = ( ALLTH(L)/  SHOPHRS(L))
          IF(MHRTH(L).GT.0)INDLB(L) =  (MHRTH(L)/  SHOPHRS(L))
          DCOST(L) =  (DIRLB(L)* TOTSAL(L))
          ICOST(L) =   (INDLB(L)* TOTSAL(L))
          OTHRS(L) =  (SHOPHRS(L)- (MHRTH(L)  + ALLTH(L)))
          OTCOST(L) = (TOTSAL(L)- (DCOST(L)  + ICOST(L)))
          MANNING(L) = (ASSGN(L)* 1.) / AUTH(L)
C
C         SAVE VALUES TO FILECODE 14
C
          WRITE(14,7004)WCNX(L),ALLTH(L),DCOST(L),MHRTH(L),ICOST(L),
       &OTHRS(L),OTCOST(L),AUTH(L),ASSON(L),MANNING(L)
   22 CONTINUE
C
          REWIND 14
C
C         SORT FILE BY WORKCENTERS -- WRITE FILE(SORTED)TO
C         FILECODE 18
C
          CALL SORTI(14,63,1,0,1,5,0,18)
C*****************************************************
C*         WRITE EOF MARK TO CLOSE                    *
          ENDFILE 14
          REWIND 14
C*                                                    *
C*****************************************************
          REWIND 18
C*****************************************************
          PRINT 7013
          PRINT 7006,UNIS
```

```
      PRINT 7007
      PRINT 7000
      PRINT 7009
      PRINT 7008
      PRINT 7010
      PRINT 7015
      PRINT 7011
      PRINT 7015
      PRINT 7007
C      COUNT OF RECORDS
C
      PRINT 7015
C*********************************************
C
      DO 23 N = 1,99999
       READ(10,7004,END=24)WCN,DLR,DCST,BDLR,BCOST,OTHR,OTCST,
     &AUTH2,ASSGN2,RM
C
C      IF AUTHORIZED AND ASSIGN IS EQUAL TO ZERO -
C      DO NOT PRINT OR INCLUDE WITH REPORT
C
       IF(AUTH2.EQ.0.AND.ASSGN2.EQ.0)GO TO 23
       DLR = DLR + .001
       BDLR = BDLR + .001
       OTHR = OTHR + .001
       RM = RM + .0001
       PRINT 7012,WCN,DLR,DCST,BDLR,BCOST,OTHR,OTCST,AUTH2,
     &ASSGN2,RM
       PRINT 7015
   23 CONTINUE
C
   24 PRINT 7007
      REWIND 10
C*********************************************
C*        WRITE EOF TO CLOSE                  *
      ENDFILE 10
      REWIND 10
C*                                            *
C*********************************************
      REWIND 24
      WRITE(24,7005)PEC
      REWIND 24
C*********************************************
C*        WRITE EOF MARK TO CLOSE             *
      ENDFILE 24
      REWIND 24
C*                                            *
C*********************************************
      RETURN
 7001 FORMAT(7X,A5,52X,I2,I2,3X,I2,I2,I1)
 7002 FORMAT(A5,1X,A5,1X,I2,1X,I2)
 7003 FORMAT(A5,1X,I6)
 7004 FORMAT(A5,F8.2,I6,F8.2,I6,F8.2,I6,I3,I3,F5.3)
 7005 FORMAT(A80)
 7006 FORMAT(T42,"MANPOWER ACCOUNTING SUMMARY PER WORKCENTER",
     &" FOR ",A3,//)
 7007 FORMAT(T10,121("*"))
 7008 FORMAT(T10,"*",14X,"*",3(21X,"*"),3(12X,"*"))
 7009 FORMAT(T10,"*",2X,"WORKCENTER",2X,"*",5X,
     &"DIRECT LABOR",4X,"*",3X,"INDIRECT LABOR",
```

```
      &4X,"*",5X,"OTHER LABOR",5X,"*",1X,"AUTHORIZED",1X,
      &"*",2X,"ASSIGNED",2X,"*",3X,"PERCENT",2X,"*")
 7010 FORMAT(I10,"*",14X,67("*"),2(3X,"MANNING",
      &2X,"*"),4X,"MANNED",2X,"*")
 7011 FORMAT(I10,"*",14X,"*",3(1X,"MANHOURS",1X,"*",
      &3X,"COST",3X,"*"),3(12X,"*"))
 7012 FORMAT(I10,"*",5X,A5,4X,"*",3(1X,F8.2,1X,"*",
      &I10,"*"),2(5X,I3,4X,"*"),4X,F5.3,3X,"*")
 7013 FORMAT(1H1)
 7014 FORMAT(I3,4X,A5,52X,2I2,3X,2I2,I1)
 7015 FORMAT(I10,"*",14X,"*",3(10X,"*",10X,"*"),
      &2(12X,"*"),12X,"*")
       END
C
C
C
       SUBROUTINE MURA(REC)
C--------------------------------------------------------
C
C                NOTES AND COMMENTS ABOUT ROUTINE
C                ------------------------------
C   NAME - MURA
C   INPUT ARGUMENT - REC
C   VARIABLES USED - JDAY
C                    JUL
C                    KEC
C                    REC
C   CALLED FROM - MAINLINE
C   SUPPORTING SUBROUTINES - PREP
C
C   DESCRIPTION OF VARIABLES
C   ----------------------
C   JDAY - JULIAN DAY FROM INPUT RECORD
C   JUL - JULIAN DAY LIMIT
C   KEC - SINGLE IMAGE OF REC
C   REC - INPUT RECORD
C   MNTS - CURRENT MONTH
C   JUL3 - UPPER LIMIT OF INPUT JULIAN DATES
C   JUL4 - LOWER LIMIT OF INPUT JULIAN DATES
C   ------------------------------------
C
C--------------------------------------------------------
      COMMON IXT,NJUL,KJUL,IZM,JUL,JUL3,JUL4,MNTS
      CHARACTER REC*1(80),KEC*80,MNTS*3
C      FILECODES (24-MURACT,27-TEMPORARY)
C      GET JULIAN DAY
      ENCODE(KEC,7001)REC
      DECODE(KEC,7002)JDAY
      IF(JDAY.GE.JUL4.AND.JDAY.LE.JUL3.AND.JUL.GT.3)GO TO 1
      GO TO 2
C* UPDATE FILE
    1 WRITE(24,7003)KEC
      IZM = 1
      RETURN
    2 JUL = JDAY
      CALL PREP
      BACKSPACE 27
      RETURN
 7001 FORMAT(80A1)
 7002 FORMAT(I3)
```

```
 7003 FORMAT(A80)
      END
C
C
C
      SUBROUTINE MNTHLY
      COMMON IXT,MJUL,KJUL,IZM,JUL,JUL3,JUL4,MNTS
C      FILECODES (19-WORKCODE,20-QC,18-TEMPORARY,17-TEMPORARY)
      REWIND 18
      REWIND 19
    1 I18 = 0
      REWIND 20
      I20 = 0
      CHARACTER WUCX*5,NOMEN*10,WUC*5,MNTS*3
C
      DO 2 I = 1,99999
       READ(20,7004,END=3)WUCX
       IF(WUCX.EQ." ")GO TO 2
       I20 = 1
    2 CONTINUE
C
    3 I = I - 1
      REWIND 20
      KDISP = 0
      IF(I20.EQ.0)RETURN
C
C           READ QC FILE AND TOTAL DISCREPANCIES
      DO 4 KLC = 1,99999
       READ(20,7002,END=5)JUL2,WUC,JDISP
       IF(JUL2.GE.JUL3.OR.JUL2.LT.JUL4)GO TO 4
       KDISP = KDISP + JDISP
    4 CONTINUE
C
C      IGOT = TOTAL DISCREPANCIES
    5 IGOT = KDISP
C
C      OPEN WORKCODE FILE
      DO 8 K = 1,99999
       REWIND 20
       READ(19,7009,END=9)WUCX,NOMEN
       ICOUNT = 0
C
       DO 6 JJJ = 1,99999
        READ(20,7002,END=7)JUL2,WUC,JDISP
        IF(JUL2.GE.JUL3.OR.JUL2.LT.JUL4)GO TO 6
        IF(WUC.EQ.WUCX)ICOUNT = ICOUNT + JDISP
    6  CONTINUE
C
    7  IF(ICOUNT.EQ.0)GO TO 8
C      COMPUTE RATE ON DISCREPANCIES
       RATE = (ICOUNT * 1.)/ IGOT
       WRITE(18,7003)WUCX,NOMEN,ICOUNT,RATE
       I18 = 1
    8 CONTINUE
C
    9 CONTINUE
      REWIND 19
      IF(I18.EQ.0)GO TO 12
C
C      SORT FILE BY RATE
```

```
C     WRITE SORTED FILE TO FILECODE 17
C
      CALL SORT1(18,20,1,0,24,5,1,17)
      REWIND 18
C*****************************************************
C*       WRITE EOF MARK TO CLOSE                     *
      ENDFILE 18
      REWIND 18
C*                                                   *
C*****************************************************
      PRINT 7001,UNIS
C
C      PRINT REPORT FROM FILECODE 17
      DO 10 JAC = 1,99999
       READ(17,7005,END=11)WUCX,NOMEN,NUMDISC,PERDISC
       PRINT 7006,WUCX,NOMEN,NUMDISC,PERDISC
       PRINT 7007
   10 CONTINUE
C
   11 PRINT 7008
      REWIND 17
C*****************************************************
C*       WRITE EOF MARK TO CLOSE                     *
      ENDFILE 17
      REWIND 17
C*                                                   *
C*****************************************************
C
   12 RETURN
 7001 FORMAT(1H1,T49,"QUALITY CONTROL OUTPUT",/,
     &T47,"FOR ALL TYPES OF INSPECTIONS FOR ",A3,/,
     &//,T21,86("*"),/,T21,"*",T39,"*",T59,"*",T82,"*",T106,"*",/,
     &T21,"*",T39,"*",T55,"*",T82,"*",T90,"PERCENTAGE",T106,"*",/,
     &T21,"* WORK UNIT CODE  *  NOMENCLATURE *  NUMBER OF ",
     &"DISCREPANCIES *  OF ALL DISCREPANCIES *",/,
     &T21,"*",T39,"*",T55,"*",T82,"*",T106,"*",/,
     &T21,86("*"))
 7002 FORMAT(9X,I3,11X,A5,1X,I2)
 7003 FORMAT(1X,45,1X,A10,1X,I4,1X,F5.3)
 7004 FORMAT(23X,A5)
 7005 FORMAT(1X,A5,1X,A10,1X,I4,1X,F5.3)
 7006 FORMAT(T21,"*",T26,A6,7X,"*",2X,A10,3X,"*",
     &11X,I2,13X,"*",8X,F6.3,T106,"*")
 7007 FORMAT(T21,"*",T39,"*",T55,"*",T82,"*",T106,"*")
 7008 FORMAT(T21,86("*"))
 7009 FORMAT(A5,1X,A10)
      END
C
C
C
      SUBROUTINE CARE
      COMMON IXT,NJUL,KJUL,IZM,JUL,JUL3,JUL4,MNIS
      CHARACTER MNIS*3
      CALL GTCHK(10)
      CALL GRAPH
      CALL MNTHLY
      CALL FAN
      REWIND 20
      READ(20,7001)JUL,IXT,NJUL,KJUL
      IF(JUL.GE.152)REWIND 20
```

```
      IF(JUL.GE.152)WRITE(28,7001)JUL,IXT,JUL,KJUL
      IF(JUL.GE.152)REWIND 28
      IF(JUL.GE.152)NJUL = JUL
      CALL MAINT
      IF(IQ.EQ.1)CALL PSEQ
      CALL NOSPWC
      IF(IQ.EQ.1)CALL PRODELT
      REWIND 28
      READ(28,7001)JUL,IXT,NJUL,KJUL
      IF(JUL.GE.244)REWIND 28
      IF(JUL.GE.244)WRITE(28,7001)JUL,IXT,NJUL,JUL
      IF(JUL.GE.244)REWIND 28
      IF(JUL.GE.244)KJUL = JUL
      CALL EMAINT
      REWIND 28
      CALL EOF
      IZM = 0
C      GET NEW JULIAN DAY LIMIT
      CALL READNC(JUL)
C      UPDATE JULIAN DAY FILE
      CALL PUTJUL
      RETURN
 7001 FORMAT(I3,1X,I3,1X,I3,1X,I3)
      END
C
C
C
      SUBROUTINE PREP
      COMMON IXT,NJUL,KJUL,IZM,JUL,JUL3,JUL4,MNTS
      CHARACTER MNTS*3
      INTEGER YEAR(14)/1,32,60,91,121,152,182,213,244,274,305,335,367,32
     &/
C
      DO 2 I = 2,14
C
       DO 1 J = YEAR(I-1),YEAR(I)- 1
        IF(JUL.EQ.J)GO TO 3
    1  CONTINUE
C
C
    2 CONTINUE
C
    3 JUL = YEAR(I + 1)
      IF(JUL.EQ.367.AND.JUL4.EQ.305)RETURN
      IF(JUL.EQ.032.AND.JUL4.EQ.305)GO TO 4
      CALL PUTJUL
    4 CALL PAPE
      RETURN
      END
C
C
C
      SUBROUTINE PROD(REC)
      COMMON IXT,NJUL,KJUL,IZM,JUL,JUL3,JUL4,MNTS
C      FILECODES (29-PROD,27-TEMPORARY)
      CHARACTER REC*1(80),KEC*80,MNTS*3
C* GET JULIAN DAY
      ENCODE(KEC,7001)REC
      DECODE(KEC,7002)JDAY
      IF(JDAY.GE.JUL4.AND.JDAY.LE.JUL3.AND.JUL.GT.32)GO TO 1
```

```
      GO TO 2
C* UPDATE FILE
    1 WRITE(29,7003)REC
      IZM = 1
      RETURN
    2 JUL = JDAY
      CALL PREP
      BACKSPACE 27
      RETURN
 7001 FORMAT(80A1)
 7002 FORMAT(I3)
 7003 FORMAT(A80)
      END
C
C
C
      SUBROUTINE PRODELT
C      FILECODES (21-DELETE,14-SCRATCH,29-PROD)
      REWIND 21
      REWIND 14
      REWIND 29
      CHARACTER CARD*80,CARDS*80
      CHARACTER PEC*80/" "/
C
C*       RANDOMLY SAVE VALUE THAT HAS BEEN PLOTTED THIS MONTH
C
      PEC = " "
C
      DO 3 I = 1,99999
       READ(21,7001,END=4)CARD
C
       DO 2 J = 1,99999
        READ(29,7001,END=3)CARDS
C
C*****************************************************************
C*   KOMPCH   IS (CREATE)HONEYWELL ROUTINE WHICH                 *
C*   COMPARES TWO FIELDS OF AN ARRAY...                          *
C*   <<<<<<<<<<<<<<<<<<<<<<<<<EASILY CHANGED>>>>>>>>>>>>>>       *
C*****************************************************************
C
        IF(KOMPCH(CARD,13,20,CARDS,13))1,2,1
    1   WRITE(14,7001)CARDS
    2  CONTINUE
C
    3 CONTINUE
C
    4 REWIND 29
      REWIND 14
C
      DO 5 I = 1,99999
       READ(14,7001,END=6)CARD
       WRITE(29,7001)CARD
    5 CONTINUE
C
    6 REWIND 29
      REWIND 21
      WRITE(21,7001)PEC
      REWIND 21
C***************************************************
C*        WRITE EOF MARK TO CLOSE                  *
```

```
      ENDFILE 21
      REWIND 21
C*                                          *
C********************************************
      REWIND 14
C********************************************
C*       WRITE EOF MARK TO CLOSE            *
      ENDFILE 14
      REWIND 14
C*                                          *
C********************************************
      RETURN
 7001 FORMAT(A80)
      END
C
C
C
      SUBROUTINE PSER
      COMMON IXT,?JUL,KJUL,I7M,JUL,JUL3,JUL4,MNTS
      CHARACTER SERIAL*8,SER*8(100),MD*7,MDS*7(100)
      CHARACTER MNTS*3
      INTEGER ICREWS(100),ICREW
C      FILECODES (29,PROD,14-SCRATCH,13-MDSMNHRS,18-TEMPORARY)
      REAL TIME(100)
      I29 = 0
      REWIND 29
      DO 1 IK = 1,100
       TIME(IK) = 0.0
       ICREWS(IK) = 0
       SER(IK) = " "
    1 CONTINUE
C
C        GET UNIQUE MDS FROM PROD FILE
C
      I = 1
      READ(29,7003,END=6)SER(I),MDS(I),ISTART,IGO,ISTOP,IGONE,
     A ICREW
      I29 = 1
      J = 1
      GO TO 4
    2 READ(29,7003,END=6)SERIAL,MD,ISTART,IGO,ISTOP,IGONE,ICREW
C
      DO 3 J = 1,I
       IF(SERIAL.EQ.SER(J))GO TO 4
    3 CONTINUE
C
      I = I + 1
      SER(I) = SERIAL
      MDS(I) = MD
      J = I
    4 ICREWS(J) = ICREW
C
C     COMPUTE TIME PHASE FOR TOTAL MAN-HOUR USED
C
      IF(ISTOP.LE.ISTART.AND.IGONE.LE.IGO)ISTOP = ISTOP + 24
      IF(IGONE.LT.IGO)ISTOP = ISTOP - 1
      IF(IGONE.LT.IGO)IGONE = IGONE + 60
      IHOTH = ISTOP - ISTART
      IHOTHS = IGONE - IGO
      IEACH = IHOTH * ICREWS(J)
```

```
      IEACHS = IROTHS + ICREWS(J)
    5 IF((IEACHS.GE.60))IEACH = IEACH + 1
      IF((IEACHS.GE.60))IEACHS = IEACHS - 60
      IF((IEACHS.GE.60)GO TO 5
      IF((IEACHS.GE.0)IEACHS = (IEACHS / 60.)
      TIME(J) = TIME(J)+ (IEACH + EACHS)
C
      GO TO 2
    6 REWIND 29
      IF(I29.EQ.0)GO TO 13
      REWIND 14
      REWIND 13
      REAL LEFT
C
      I14 = 0
C      OPEN MDSHURS FILE
      DO 9 K = 1,99999
       HOLD = 0.0
       OVER = 0.0
       LEFT = 0.0
       READ(13,7001,END=10)MD,IAUTH
C
C   COMPARE FILE WITH UNIQUE MDS FOUND
       DO 7 L = 1,I
        IF(MD.EQ.MDS(L))GO TO 8
    7  CONTINUE
C
       GO TO 9
    8  HOLD = (IAUTH + 1.) - TIME(L)
       I14 = 1
C   COMPUTE MAN-HOURS LEFT TO WORK OR WORKED OVER
       IF(HOLD.LT.0.0)OVER = (HOLD * (-1.))
       IF(HOLD.GE.0.0)LEFT = HOLD
       WRITE(14,7002)MDS(L),SER(L),IAUTH,TIME(L),LEFT,OVER
    9 CONTINUE
C
   10 REWIND 14
      REWIND 13
      IF(I14.EQ.0)GO TO 13
C      SORT BY SERIAL NUMBER WRITE SORTED FILE TO
C      FILECODE 18
      CALL SORT1(14,37,1,0,0,0,0,18)
      REWIND 14
C*****************************************
C*       WRITE EOF MARK TO CLOSE          *
      ENDFILE 14
      REWIND 14
C*                                        *
C*****************************************
      REWIND 18
C      PRINT PRODUCTION SUMMARY HEADINGS
      PRINT 7004,AMIS
      PRINT 7005
      PRINT 7006
      PRINT 7007
      PRINT 7006
      PRINT 7005
      PRINT 7006
C************************************************************
C
```

```
      DO 11 K = 1,99999
       READ(18,7002,END=12)MD,SERIAL,IAUTH,TIMES,LEFT,OVER
       IF(OVER.LE.0.0)OVER = OVER + .001
       IF(LEFT.LE.0.0)LEFT = LEFT + .001
       IF(TIMES.LE.0.0)TIMES = TIMES + .001
       PRINT 7008,MD,SERIAL,TIMES,IAUTH,LEFT,OVER
       PRINT 7006
   11 CONTINUE
C
   12 PRINT 7005
   13 REWIND 10
C********************************************
C*          WRITE EOF TO CLOSE              *
      ENDFILE 18
      REWIND 18
C*                                          *
C********************************************
      RETURN
 7001 FORMAT(A7,1X,I4)
 7002 FORMAT(A7,A8,I4,F6.2,F6.2,F6.2)
 7003 FORMAT(12X,A8,7X,A7,30X,2I2,3X,2I2,I1)
 7004 FORMAT(1H1,T45,"PRODUCTION SUMMARY FOR BASE"," FOR ",A3,//)
 7005 FORMAT(T30,72("*"))
 7006 FORMAT(T30,"*",T41,"*",T53,"*",T65,"*",T77,"*",
     &T89,"*",T101,"*")
 7007 FORMAT(T30,"*",3X,"MDS",4X,"*",1X,"SERIAL NO.*",2X,"M/H USED",
     &1X,"*",2X,"M/H AUTH",1X,"*",2X,"M/H LEFT",1X,"*",2X,
     &"M/H OVER",1X,"*")
 7008 FORMAT(T30,"*",1X,A7,2X,"*",1X,A8,2X,"*",1X,F9.2,1X,
     &"*",1X,I9,1X,"*",2(1X,F9.2,1X,"*"))
      END
C
C
C
      SUBROUTINE PUTJUL
      COMMON IXI,NJUL,KJUL,I7M,JUL,JUL3,JUL4,MNTS
      CHARACTER MNTS*3
C      FILECODES (20-JULIAN)
C      SET UP NEW PARAMETERS
      NA=91
      NB=121
      NC=152
      ND=182
      NE=213
      NF=244
      NG=274
      NH=305
      NI=335
      NJ=367
      NK=32
      NL=60
C      SAVE FOLLOWING JULIAN DAY WITH CURRENT
      IF(JUL.EQ.367)WRITE(20,7001)JUL,NK,NJUL,KJUL
      IF(JUL.EQ.32)WRITE(20,7001)JUL,NL,NJUL,KJUL
      IF(JUL.EQ.60)WRITE(20,7001)JUL,NA,NJUL,KJUL
      IF(JUL.EQ.91)WRITE(20,7001)JUL,NB,NJUL,KJUL
      IF(JUL.EQ.121)WRITE(20,7001)JUL,NC,NJUL,KJUL
      IF(JUL.EQ.152)WRITE(20,7001)JUL,ND,NJUL,KJUL
      IF(JUL.EQ.182)WRITE(20,7001)JUL,NE,NJUL,KJUL
      IF(JUL.EQ.213)WRITE(20,7001)JUL,NF,NJUL,KJUL
```

```
      IF(JUL.EQ.244)WRITE(28,7001)JUL,NQ,NJUL,KJUL
      IF(JUL.EQ.274)WRITE(28,7001)JUL,NU,NJUL,KJUL
      IF(JUL.EQ.305)WRITE(28,7001)JUL,NI,NJUL,KJUL
      IF(JUL.EQ.335)WRITE(28,7001)JUL,NJ,NJUL,KJUL
C*******************************************************
      REWIND 28
      CALL LIMIT
      CALL LIMITX
      RETURN
 7001 FORMAT(I3,1X,I3,1X,I3,1X,I3)
      END
C
C
C
      SUBROUTINE OCRPI(REC)
      COMMON IXT,NJUL,KJUL,IZM,JUL,JUL3,JUL4,MNTS
C      FILECODES (20-OC,27-TEMPORARY)
      CHARACTER REC*1(80),KEC*80,MNTS*3
C* GET JULIAN DAY
      ENCODE(KEC,7001)REC
      DECODE(KEC,7002)JDAY
      IF(JDAY.GE.JUL4.AND.JDAY.LE.JUL3.AND.JUL.GT.32)GO TO 1
      GO TO 2
C*UPDATE FILE
    1 WRITE(20,7003)KEC
      IZM = 1
      RETURN
    2 JUL = JDAY
      CALL PREP
      BACKSPACE 27
      RETURN
 7001 FORMAT(80A1)
 7002 FORMAT(9X,I3)
 7003 FORMAT(A80)
      END
C
C
C
      SUBROUTINE OTCHK(IQ)
C      SCAN FILE - IF TYPES MATCH RETURN THE TYPE
C     CODE NUMBER AND TOTAL NUMBER OF TYPES.
C
C      IF TYPES NEVER MATCH ADD NEW TYPE - RETURN
C     ITS CODE NUMBER AND TOTAL NUMBER OF TYPES
C
      COMMON IXT,NJUL,KJUL,IZM,JUL,JUL3,JUL4,MNTS
      CHARACTER MNTS*3
      INTEGER YRS(4)/121,213,305,1/
C
C*******************************************************
C*  THIS PARAMETER MUST BE CHANGED... DEPENDING *
C* ON THE MONTH THAT PROGRAM IS IMPLEMENTED     *
C* -------------------------------------------- *
C* IF MONTH WAS - CODE SHOULD BE - QUARTER ENDS *
C* -------------------------------------------- *
C* JANUARY      -      152       - MARCH        *
C* FEBRUARY     -      182       - APRIL        *
C* MARCH        -      213       - MAY          *
C* APRIL        -      244       - JUNE         *
C* MAY          -      274       - JULY         *
```

```
C* JUNE          -      305      - AUGUST        *
C* JULY          -      335      - SEPTEMBER     *
C* AUGUST        -      367      - OCTOBER       *
C* SEPTEMBER     -      032      - NOVEMBER      *
C* OCTOBER       -      060      - DECEMBER      *
C* NOVEMBER      -      091      - JANUARY       *
C* DECEMBER      -      121      - FEBRUARY      *
C*************************************************
C
      YRS(1) = 152
      YRS(2) = 244
      YRS(3) = 335
      YRS(4) = 060
      IQ = 0
C
      DO 1 I = 1,4
       IF(JUL.EQ.YRS(I))IQ = 1
    1 CONTINUE
C
      RETURN
      END
C
C
C
      SUBROUTINE READNC(NC)
C      FILECODES (20-JULIAN)
C
C      READ NEXT JULIAN DAY LIMIT
C
      READ(20,7001)NC
      REWIND 20
      RETURN
 7001 FORMAT(4X,I3)
      END
C
C
C
      SUBROUTINE TYPECHK(TYPES,I,J)
C      FILECODE (10-TYPEFILE)
      CHARACTER TYPES*5,TYPEN*5
C
C
    1 DO 2 I = 1,99999
       READ(10,7001,END=3)TYPEN
       IF(TYPEN.EQ."     ")GO TO 3
       IF(TYPES.EQ.TYPEN)GO TO 4
    2 CONTINUE
C
C
C      ADD NEW TYPE
C
    3 BACKSPACE 10
      WRITE(10,7001)TYPES
    4 REWIND 10
      J = 1
C
C      COUNT ALL TYPES
C
      DO 5 K = 1,99999
       READ(10,7001,END=6)TYPEN
```

```
    5 CONTINUE
C
    6 I = K - 1
      REWIND 10
      RETURN
 7001 FORMAT(A5)
      END
C
C
C
      SUBROUTINE TYPERAND(JTO,RR,N20,IDP)
      INTEGER RR(12,100)
C
C*      RANDOM RETRIEVAL OF VALUES THAT HAVE BEEN PLOTTED
C*      THIS YEAR.
C
      IF(IDP.EQ.1)READ(09'JTO)(RR(N2,JTO),N2 =1,N20)
      IF(IDP.EQ.2)WRITE(09'JTO)(RR(N2,JTO),N2 = 1,N20)
      RETURN
      END
C
C
C
      SUBROUTINE UNIQUE
      CHARACTER WHC*5(100),WUCY*5,NOMEN*10(100),NOM*10
      INTEGER L1(100),L2(100),L3(100),L4(100),L5(100),L6(100)
      INTEGER L7(100),L8(100),LA(100),LB(100)
      REAL L9(100),L0(100),K9,K0
C      FILECODES (14-SCRATCH,16-SUMMARY)
      I14 = 0
C
C      ZERO OUT ALL ACCUMULATORS
C
      DO 1 II = 1,100
       L1(II) = 0
       L2(II) = 0
       L3(II) = 0
       L4(II) = 0
       L5(II) = 0
       L6(II) = 0
       L7(II) = 0
       L8(II) = 0
       L9(II) = 0.0
       L0(II) = 0.0
       LA(II) = 0
       LB(II) = 0
    1 CONTINUE
      K1 = 0
      K2 = 0
      K3 = 0
      K4 = 0
      K5 = 0
      K6 = 0
      K7 = 0
      K8 = 0
      K9 = 0
      K0 = 0
      KA = 0
      KB = 1
      I = 0
```

```
      I = I + 1
      REWIND 14
C
C      READ FILECODE 14 (ESTABLISHED IN ERS)AND GET
C     ALL OUTPUT TYPES.
C
      READ(14,2001,END=5)WUC(I),NOMEN(I),L1(I),L2(I),L3(I),L4(I),
     &L5(I),L6(I),L7(I),L8(I),L9(I),L0(I),LA(I),LB(I)
      I14 = 1
      J = 1
      GO TO 4
    2 K1=0
      K2=0
      K3=0
      K4=0
      K5=0
      K6=0
      K7=0
      K8=0
      K9=0.0
      K0=0.0
      KA=0
      KB=0
      READ(14,2001,END=5)WUCX,NOM,K1,K2,K3,K4,K5,K6,K7,K8,K9,
     &K0,KA,KB
C
      DO 3 J = 1,I
        IF(WUCX.EQ.WUC(J))GO TO 4
    3 CONTINUE
C
      I = I + 1
      J = I
      WUC(I) = WUCX
      NOMEN(I) = NOM
C
C      TOTAL ALL PARAMETERS FOR ESUM REPORT
C
    4 IF(L1(J).EQ.0)L1(J) = L1(J)+ K1
      IF(L2(J).EQ.0)L2(J) = L2(J)+ K2
      IF(L3(J).EQ.0)L3(J) = L3(J)+ K3
      IF(L4(J).EQ.0)L4(J) = L4(J)+ K4
      IF(L5(J).EQ.0)L5(J) = L5(J)+ K5
      IF(L6(J).EQ.0)L6(J) = L6(J)+ K6
      IF(L7(J).EQ.0)L7(J) = L7(J)+ K7
      IF(L8(J).EQ.0)L8(J) = L8(J)+ K8
      IF(L9(J).EQ.0.0)L9(J) = L9(J)+ K9
      IF(L0(J).EQ.0.0)L0(J) = L0(J)+ K0
      IF(LA(J).EQ.0)LA(J) = LA(J)+ KA
      IF(LB(J).EQ.0)LB(J) = LB(J)+ KB
      GO TO 2
    5 REWIND 14
C
C
C      WRITE TOTALS TO FILECODE 14
C
      DO 6 K = 1,I
        WRITE(14,2001)WUC(K),NOMEN(K),L1(K),L2(K),L3(K),L4(K),
     &L5(K),L6(K),L7(K),L8(K),L9(K),L0(K),LA(K),LB(K)
    6 CONTINUE
C
```

```
      REWIND 14
      IF(I14.EQ.0)RETURN
C
C      SORT FILE BY WORK-UNIT-CODE..
C     WRITE SORTED FILE TO SUMMARY
C
      CALL SORT1(14,67,1,0,1,5,0,16)
C********************************************
C*            WRITE EOF MARK TO CLOSE       *
      ENDFILE 14
      REWIND 14
C*                                          *
C********************************************
      RETURN
 7001 FORMAT(A5,A10,8I4,2I6.2,2I4)
      END
```

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Captain Callahan, a native of St. Paul, Minnesota, received his BA Degree in International Relations from St. Thomas College. While at college, Captain Callahan participated in the AF ROTC program which resulted in an Air Force commission in May of 1970. After commissioning, he served in many assignments as a logistics officer, the latest of these assignments being as a Supply Officer at Korat Royal Thai Air Base, Thailand. While at AFIT Captain Callahan was selected into the Sigma Iota Epsilon honorary fraternity. After graduation from AFIT, he was assigned as career advisor to the Air Force Reserve Personnel Center, Lowry AFB, Colorado.

Squadron Leader Payne attended the King's School Parramatta, graduating in 1967; he was admitted to the degree of Bachelor of Economics from the Australian National University in 1970 and subsequently joined the Royal Australian Air Force and was commissioned in 1971 as an Equipment Officer. He has had supply experience in equipment warehousing, barracks and messing, and three years as Officer in Charge of the 7SD Cadet Flight. After AFIT Squadron Leader Payne has been posted to the Australian Department of Defense (Air Force Office) in Canberra.